MAV-PACK®

MOTOROLA
AUDIO-
VISUAL
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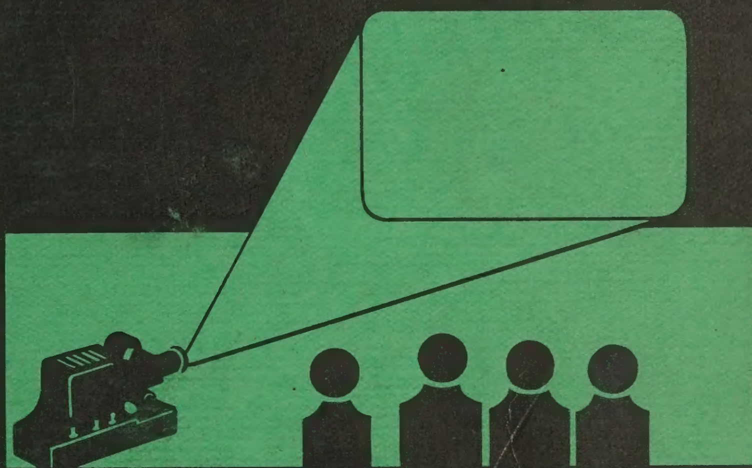
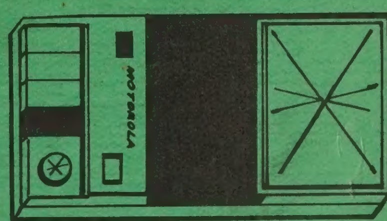
TRAINING SCHOOL





NATIONAL
MOTOROLA
COMMUNICATIONS
SERVICE

COURSE TYA

D. C. REMOTE CONTROL FOR BASE STATIONS, MODULE CIRCUITS AND SERVICING

MOTOROLA Communications and Electronics Inc.

Produced by TECHNICAL TRAINING DEPARTMENT

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC.
Motorola Technical Training Department

MAV-PACK COURSE NO. TYA

D.C. REMOTE CONTROL SYSTEM FOR BASE STATION MODULE CIRCUITS AND SERVICING

CASSETTE "INDEX-LOCATOR"

To locate any specific section of the lecture recording relative to any frame on the filmstrip.

Note: "Elapsed Time" is elapsed time in minutes and seconds of each Cassette from start of tape to the beep for changing to the next frame.

Set up and focus on "Focus Frame". Move projector to next frame, a black frame; start recorder and projector. Advance projector one frame each time you hear a beep. Keep frames synchronized with the frame references by the instructor.

Elapsed Time	Side No.	Filmstrip Frame No.	Title of Section/Frame
Start	1	—	"Turn-On"
0:00	1	—	First "beep" Title Frame—MAV-PACK Course TYA—D.C. Remote Control System for Base Station Module Circuits and Servicing
2:55	1	Next	Photo—Base Station Training System
5:36	1	1	Title—Course TYA—D.C. Remote Control System for Base Station Module Circuits and Servicing
6:09	1	2	Photo—Remote Control Upright Base Station
6:26	1	3	Photo—Remote Control Compa Station with Remote Console
6:45	1	4	Photo—Remote Control Console with Microphone
7:14	1	5	Drawing—Remote Control Lines
7:54	1	6	Title—D.C. Current Requirements
8:30	1	7	Photo—D.C. Remote Control Chassis
9:22	1	8	Photo—Motherboard (Front View)
10:09	1	9	Photo—Motherboard (Rear View)
10:33	1	10	Photo—D.C. Remote Control Chassis
10:52	1	11	Photo—Station Logic Module
11:43	1	12	Photo—D.C. Transfer Module 2 Frequency
12:10	1	13	Photo—D.C. Transfer Module 1 Frequency
12:33	1	14	Photo—Line Driver Module
13:08	1	15	Photo—D.C. Remote Control Chassis
13:21	1	16	Title—Summary
13:34	1	17	Title—D.C. Continuity
13:46	1	18	Title— +10.0 MA, +5.5 MA, —2.5 MA, —5.5 MA
14:20	1	19	Photo—D.C. Remote Control Chassis
15:02	1	20	Title—Who, What, Why, How, When?
15:23	1	21	Title—Simplified Block Diagrams
15:52	1	22	Drawing—Block Diagram—F1 Transmit
18:38	1	23	Drawing—Block Diagram—F2 Transmit
20:18	1	24	Drawing—Block Diagram—"P.L." Disable
21:24	1	25	Drawing—Block Diagram—Mute R2
23:13	1	26	Title—Review
23:21	1	27	Title—Each Function has its own Detector
23:42	1	28	Title—Multiple Use of Control Circuits
23:59	1	29	Title—Safeguards
24:33	1	30	Title—Logic Symbols
25:07	1	31	Drawing Inverter
26:41	1	32	Drawing—AND Gate
28:30	1	—	End of Side 1
0:00	2	—	**Start of Side 2**
0:05	2	33	Drawing—OR Gate
1:30	2	34	Title—Take a Break
1:40	2	35	Title—Detailed Functional Diagrams
2:04	2	36	Functional—Detailed Functional Diagram—D.C. Remote Control
2:54	2	37	Title—Transmit on F1
3:11	2	38	Functional—Line Current—F1 Transmit Function
4:04	2	39	Functional—Line Current—F1 Transmit Function
5:13	2	40	Functional—F1 Push-To-Talk Sequence
8:17	2	41	Functional—Local Mike Circuit
9:50	2	42	Functional—Push-To-Talk Circuit
11:33	2	43	Functional—Redundancy Circuit
13:06	2	44	Functional—A+ Switch Circuit
14:58	2	45	Functional—F1 Oscillator Circuit
16:32	2	46	Functional—Antenna Relay Circuit
17:32	2	47	Title—Station Transmitting on Frequency 1
18:15	2	48	Functional—Line Driver Switch Circuit

Elapsed Time	Side No.	Filmstrip Frame No.	Title of Section/Frame
19:00	2	49	Functional—Exciter Amplifier
19:51	2	50	Functional—Exciter Audio Circuit
20:51	2	51	Functional—F1 Turn Off
23:42	2	52	Functional—F1 Turn Off
25:26	2	53	Title—Transmitter Off the Air
26:18	2	—	End of Side 2
0:00	3	—	**Start of Side 3**
0:05	3	54	Title—Transmit on F2
0:17	3	55	Functional—F2 Transmit Sequence
4:51	3	56	Title—"P.L." Disable
5:13	3	57	Functional—Negative Line Current
5:48	3	58	Functional—Negative Line Current
6:23	3	59	Functional—"P.L." Disable Sequence
9:56	3	60	Title—Receiver No. 2 Mute
10:17	3	61	Functional—Mute R2 Sequence
14:44	3	62	Functional—Mute R2 Reset
16:59	3	63	Title—Local Control
17:08	3	64	Photo—Local Control Panel
17:49	3	65	Functional—Local Control Circuit
20:21	3	66	Title—Take A Break
20:29	3	67	Title—D.C. Remote Control Module Schematic Diagrams
21:00	3	68	Photo—Station Logic Module
21:30	3	69	Schematic—Keying Circuit
28:37	3	—	End of Side 3
0:00	4	—	**Start of Side 4**
0:05	4	70	Schematic—Audio Circuit
4:55	4	71	Photo—D.C. Transfer Module 2 Frequency
5:52	4	72	Schematic—Positive Transfer Oscillator
9:20	4	73	Schematic—Push-To-Talk and F1 Circuits
13:23	4	74	Schematic—Bias Generator
14:48	4	75	Schematic—F1-F2 Bistable and Switch Circuits
25:05	4	—	End of Side 4
0:00	5		**Start of Side 5**
0:05	5	76	Schematic—Redundancy Circuit
3:14	5	77	Schematic—F2 Circuit
7:28	5	78	Schematic—"P.L." Disable Circuit
10:02	5	79	Schematic—Mute R2 Circuit
15:11	5	80	Photo—Line Driver Module
17:07	5	81	Schematic—Transformer and Line Driver Circuit
23:25	5	—	End of Side 5
0:00	6	—	**Start of Side 6**
0:05	6	82	Schematic—Exciter/Speaker Amplifier Circuit
1:35	6	83	Schematic—Intercom Circuit
5:44	6	84	Title—Your Study Guide Contains:
6:19	6	85	Title—D.C. Remote Control Servicing Techniques
6:51	6	86	Photo—Servicing Modules Using Extender Board
8:47	6	87	Photo—TEK-38 Base Station Module Servicing Adapter
9:45	6	88	Drawing—Connection Chart Station Logic
10:34	6	89	Photo—Bench Set Up for Servicing Station Logic Module
12:11	6	90	Drawing—Connection Chart D.C. Transfer
12:34	6	91	Photo—Servicing D.C. Transfer Module
14:03	6	—	End of Side 6
		92	Title—MAV-PACK
		93	Title—The End

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MOTOROLA

COMMUNICATIONS and ELECTRONICS, INC.

TECHNICAL TRAINING DEPARTMENT

PREFACE

THE NEW "MAV-PACK" TRAINING PACKAGES

WIDESPREAD NEED FOR TECHNICAL TRAINING

The need for extensive technical training of Service Technicians has made it necessary for Motorola to develop a new and additional type of training on its Communications products.

Recognizing the increasing complexity of new products and how many there are, all of which is made possible by solid state developments, we have conducted over 1000 schools in a single year.

But, that is not enough. We cannot reach a large percent of the Technicians in the business. Many just cannot make it into our schools, even though schools were held in over one hundred cities.

Every Technician can benefit by training on a new product. In fact, this training is about the only way he can keep abreast of todays rapid developments in technology. Obviously the "new" is stressed in our training packages.

"MAV-PACK"

(MOTOROLA AUDIO-VISUAL TRAINING PACKAGE)

Our new MAV-PACK technical training package does a thorough and excellent job of training. It makes use of Cassette recordings and a synchronized filmstrip, plus a text containing theory, circuit analysis and servicing techniques. The text also contains numerous foldout schematics.

MAV-PACK is a complete technical training course on a specific product. It is designed to reach every Service Technician who services Motorola equipment.

SEVERAL WAYS TO TEACH MAV-PACK PACKAGES

MAV-PACK packages can be taught in several ways:

1. In a classroom lecture-demonstration type school, like Motorola field men have been conducting. In this case the instructor would lecture to replace the cassette recordings, or use selected parts of them and would make full use of the new filmstrip and text.

   He could interrupt the film and add pertinent field experiences, or ask questions and answer questions, or

2. One man in your shop could be selected to run the show for a group stopping for reviews and discussions of circuits, etc., or

3. MAV-PACK can be used for "self-teaching" by one man or by a group, letting it do the whole job. It is a complete training course and will stand on its own.

V Several Foldout Schematics, and other reference material.

VI Cassette "Index-Locator" pages in the front, to help you locate any section you wish to repeat or study. This shows the elapsed time from start on a Cassette at the "beep" for any frame you are looking for.

Note also that the Instructor nearly always states the next frame number. Thus, by using the indicated elapsed time and stopping to hear a frame number, you can quickly find a passage you want.

VII A set of questions for you to answer and turn in to your shop manager. There is a sealed packet of answers for the manager to open and grade your examination.

WHAT YOU DO:

So get yourself involved! Get all you can out of this MAV-PACK. Be alert. Listen for the "beeps" and change slides when they occur. When a Cassette comes to an end, turn off the unit and turn it over, or change to the next.

Adjust the focus of your projector lens for best sharpness as required.

Get involved! Follow the instructor and the filmstrip with each change of context. If he tells you to look up a reference in the book, do it! If he asks a question, try to answer it, for yourself. When he asks you to break and write answers to the set of questions, do it, right then. Or he may suggest you write a certain note on a schematic. If he suggests you take a few minutes break, or go have a cup of coffee, take the break. You can pull yourself away! Do it!!! GET YOURSELF INVOLVED.

Be sure to look through the book and all the written materials so you can follow them, or turn to them quickly, during the session.

Always have sufficient light in the room so you can read your test and follow schematics. Maybe a bench light or two, or a table lamp off to one side.

If you have a subject unit available, it is most important to have it alongside while taking the course. Look it over first, if you are not familiar with it.

NOW, LET'S GET STARTED:

1. Locate the Cassette having Side Number One (1) and place it in the recorder.

2. Thread the starting end of the Filmstrip in the projector, turn it "on", rotate the feed to the "focus" frame. Using the "framing lever", center the frame on the screen, then focus the lens.

3. Advance to the next dark frame and turn the recorder on "play".

4. When you hear the first "beep" advance to the next frame.

5. Each time you hear a beep, advance to the next frame. Watch frame numbers in lower right hand corner, so you can stay synchronized.

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COMMUNICATIONS and ELECTRONICS, INC.

TECHNICAL
TRAINING
DEPARTMENT

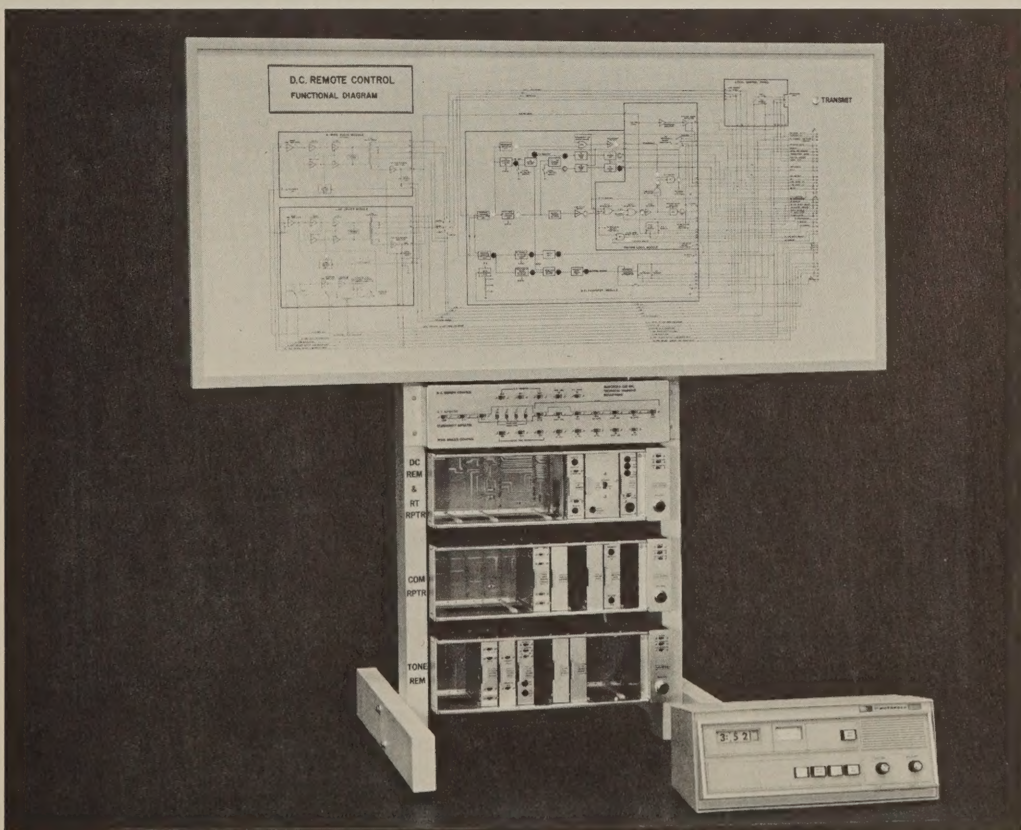
D.C. REMOTE CONTROL FOR BASE STATIONS MODULE CIRCUITS AND SERVICING

COURSE TYA

TABLE OF CONTENTS

PART I. INTRODUCTION

Course TYA MAV-PACK - D. C. Remote Control for Base Stations, Module Circuits and Servicing is a complete course in itself with the filmstrip, cassettes, and study guide, and is designed to stand on its own. It may be presented in several ways. One man, or a group of men, may run the program on their own using the filmstrip and tape cassettes provided. The program may be presented by a Motorola Field Technical Representative using the filmstrip and selected portions of the tape cassettes plus his own supplementary lectures. Or, the program could be presented by the Motorola Field Technical Representative using the filmstrip, tape cassettes, his own lectures plus the D. C. Remote Control Demonstration System for Base Stations shown in the photo.



REMOTE CONTROL BASE STATION DEMONSTRATION SYSTEM FOR D. C. CONTROL

The demonstrator contains all the circuits needed for remote control of a base station. All modules and circuits are functioning and will perform their specified tasks. By the use of red and green lamps on a functional diagram board, the sequence of operation of a function may be readily seen at a glance. In order to allow closer examination of the circuit operation, a series of inhibit switches may be used to halt the sequence until complete understanding is achieved. Then the sequence may once again be activated. The demonstrator may also be used for making voltage measurements and tests by the technician.

The demonstrator is also used for Tone Remote Control, R. T. Repeater and Community Repeater training.

To service D. C. Remote Control, a good working knowledge of the total system is the Service Technician's most important service aid. MAV-PACK Course TYA has been developed to aid you, the Technician, in acquiring this knowledge.

MAV-PACK Course TYA contains information starting with basic facts about D. C. control, then progressing through level requirements, simplified block diagrams, usage of logic symbols, system description by means of a functional diagram, a schematic study, and servicing procedures.

The study guide will contain all the facts mentioned on the tape cassettes plus supplemental information that will prove valuable as a reference on later problems.

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TYA-II

TECHNICAL TRAINING DEPARTMENT

D.C. REMOTE CONTROL FOR BASE STATIONS MODULE CIRCUITS AND SERVICING

COURSE TYA

PART II – COURSE OUTLINE

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	Fig. 1,2	
SECTION II. FEATURES AND REQUIREMENTS	PART III-A, P.1	4 - 20
	Fig. 3-10	
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B. F2 TRANSMIT	Fig. 12	23
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D. MUTE R2	Fig. 14	25
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1. Line Current	P.7	38 - 39
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3. Local Mike and P-T-T Circuit	P.7	41 - 42

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TYA-III

TECHNICAL TRAINING DEPARTMENT

D.C. REMOTE CONTROL FOR BASE STATIONS MODULE CIRCUITS AND SERVICING

COURSE TYA

PART III-A. SYSTEM DESCRIPTION

TEXT

I. INTRODUCTION

D.C. Remote Control permits distant activating of functions located on a base station. This permits the control point to be in an advantageous location close to other businesses, facilities and conveniences while allowing base station placement for maximum range and coverage. Remote control is accomplished by means of D.C. currents placed on a pair of wire lines. The various functions are selected by varying the amount of D.C. current and by the use of both positive and negative current.

D.C. Remote Control may be used with an upright base station which could be of any power output or in any frequency range, since the remote control circuits are not frequency sensitive. Remote control may also be used with a Compa-Station

FIGURE 1. REMOTE CONTROL COMPA-STATION WITH REMOTE CONSOLE

such as we see in Figure 1, again in all frequency ranges, or remote control may be used to provide the wire line control of an RT repeater, utilizing either an upright base station or a Compa-Station as the RT repeater.

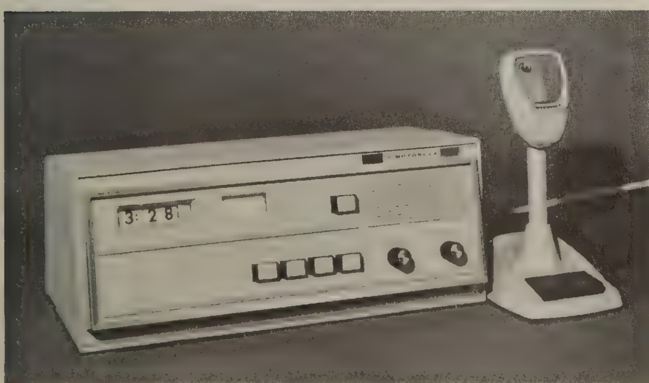


FIGURE 2. REMOTE CONTROL CONSOLE WITH MICROPHONE

D.C. remote control starts with a D.C. Remote Console. Figure 2 shows a Remote Control Console with microphone. The console contains the necessary controls and circuits to perform the desired functions. In addition to these controls and circuits, the console contains the power supply used to generate the necessary line current, plus audio circuitry for the conveying of intelligence.

II. FEATURES AND REQUIREMENTS

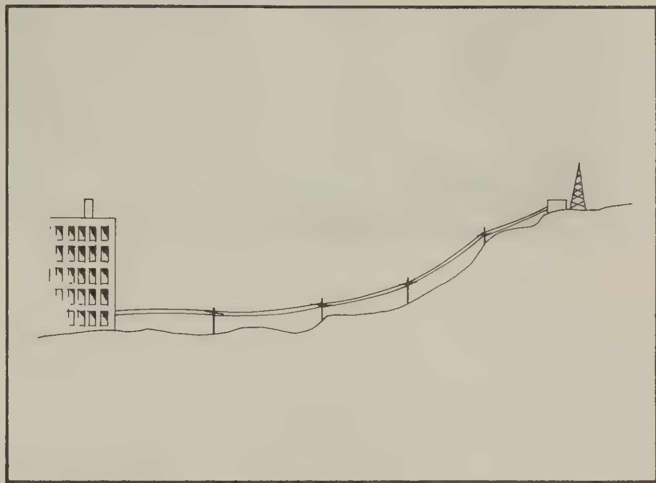


FIGURE 3. REMOTE CONTROL LINES

As was mentioned earlier, the control signals are carried by means of a pair or pairs of wire lines having D.C. continuity and a flat frequency response from D.C. to 3000 Hz. Figure 3 shows a pair of wire lines linking a control point on the left to a base station located at a distance on the right. The A.C. impedence of these lines is nominally 600 ohms and the D.C. resistance should be low enough to permit currents to reach the levels desired.

The normal functions and their required current levels are as shown in Figure 4.

Function	Current Level
F1 KEYING	+5.5 MA
F2 KEYING	+10.0 MA
"PL" DISABLE	-2.5 MA
RCVR.#2 MUTE	-5.5 MA

FIGURE 4. D. C. CURRENT REQUIREMENTS

Correct adjustment of these current levels will provide optimum operation of the system.

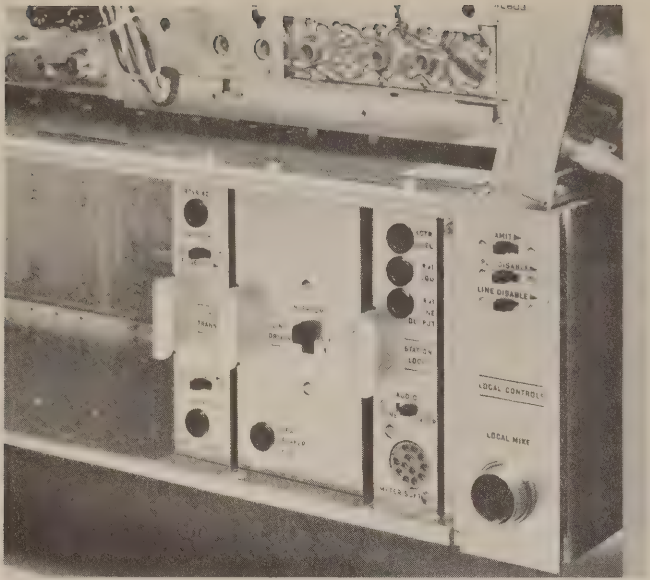
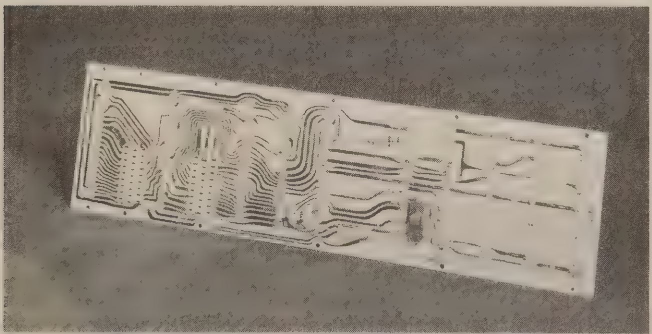


FIGURE 5. D. C. REMOTE CONTROL CHASSIS

The D.C. currents, as well as audio intelligence, are applied to the remote control chassis at the base station. Figure 5 shows a remote control unit consisting of a wraparound chassis, a motherboard and a number of plug-in modules, used to convert the D.C. line currents to switching functions.

The motherboard provides interconnection between the plug-in modules, as well as providing a location for the plugs connecting the remote control chassis to the RF portions of the stations. The plug-in modules speed maintenance and troubleshooting and optional accessory functions may be added by simply plugging in the appropriate module. Removal of a module is accomplished by grasping the handle and pulling straight out from the wraparound.



JUMPERS FOR 2OR4 WIRE

FIGURE 6. MOTHERBOARD (FRONT VIEW)

REAR OF BASE STATION

Figure 6 shows the motherboard which has printed circuits on both the front and back of the board. Cables to the RF portions of the base station terminate in connectors which mate with receptacles P9 and P10 located on the lower left sides of the board. From P9 and P10, printed lines provide the interconnection between the motherboard and the input and output connections, as well as between modules. Jumpers located on the motherboard proper permit selection of paths when using either two wire or four wire operation. The transmit switch provides a convenient means for the serviceman to key the base station while working at the rear of the unit.

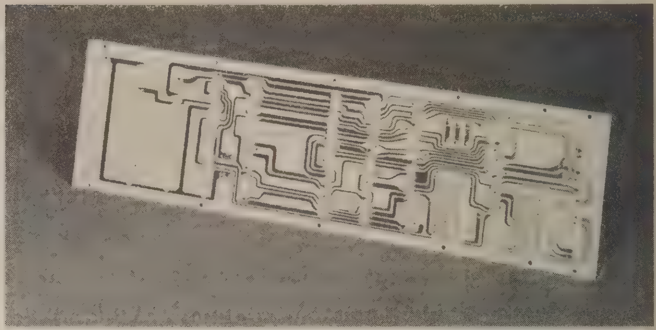


FIGURE 7. MOTHERBOARD (REAR VIEW)

Inputs and outputs to the plug-in modules are accomplished by means of pins, as seen in Figure 7, inserted in the motherboard in vertical rows which mate with connectors on the plug-in modules. The modules are properly aligned by nylon guard rails to insure mating between the pins on the motherboard and the connectors on the plug-in modules.

A basic D.C. remote control system will utilize three plug-in modules, a Station Logic module, a D.C. Transfer module and a Line Driver module, plus a Local Control panel.

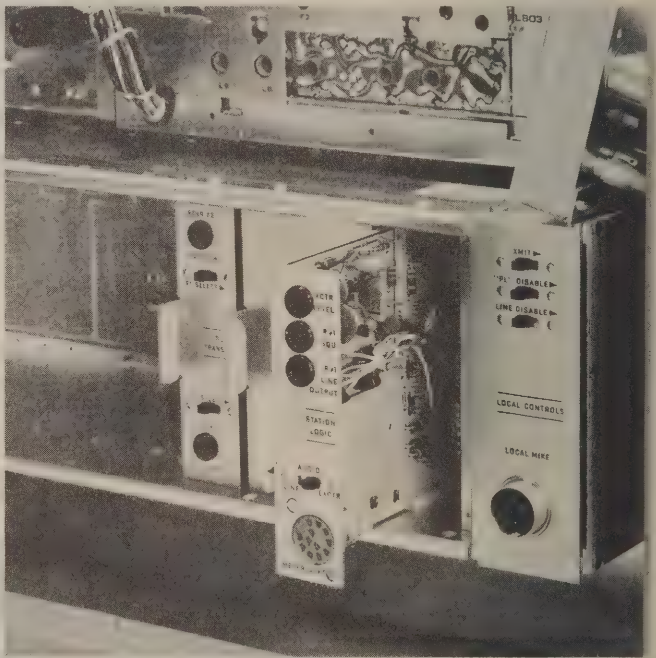


FIGURE 8. STATION LOGIC MODULE

In Figure 8 the Station Logic module shown provides sequencing, timing and control functions. It also amplifies line audio to the proper level for the exciter. Included on the module are the Exciter Level Control to set audio input to the exciter, R1 Line Output Control to set line output level, R1 Squelch Control to adjust Receiver one squelch sensitivity, a Line Exciter audio switch to select Exciter or Line audio level measurements at the

metering socket and a meter socket which permits the serviceman to connect a Motorola portable test set for servicing the remote control unit.

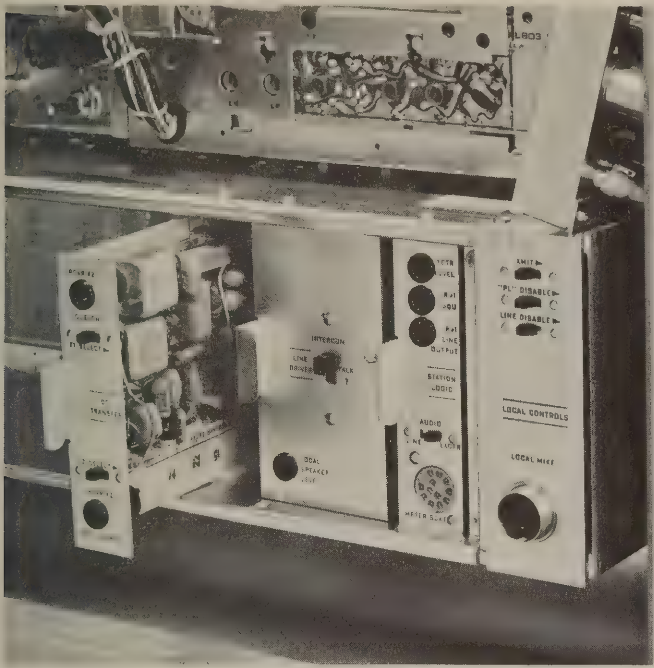


FIGURE 9. D. C. TRANSFER MODULE

The D.C. Transfer module shown in Figure 9 converts all D.C. line currents into control signals for all functions. This module contains F1 Select, F2 Select switches to permit manual selection of station operating frequency, R2 Squelch Control for adjusting Receiver two squelch sensitivity and an R2 Line Output control for setting Receiver two Line Output levels.

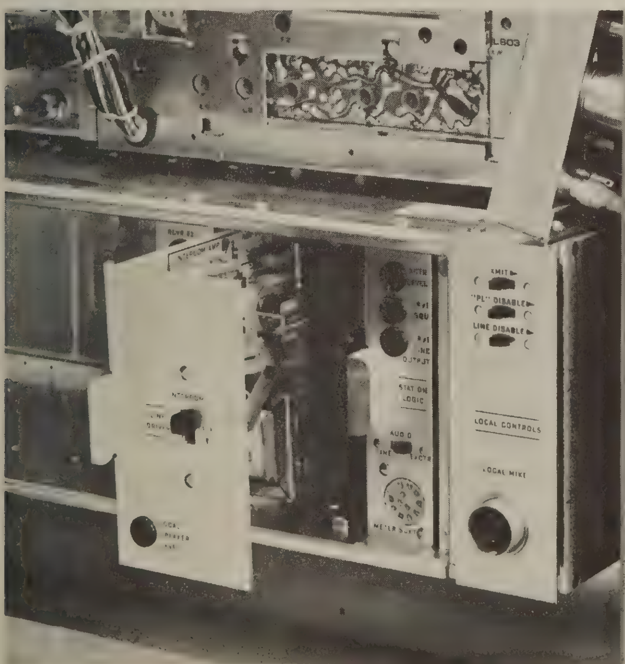


FIGURE 10. LINE DRIVER MODULE

A single frequency D.C. Transfer module is also available. Only two functions are used in this case - Transmit on F1 and "P.L." Disable. There are no controls or adjustments located on this module.

The Line Driver module, shown in Figure 10, receives the D.C. Line Current and routes the current to the control circuits.

The Line Driver module also amplifies and routes receiver audio to the remote control location and couples transmit audio from the remote control site to the transmitter. Included on this module are the Intercom switch to permit intercom operation between the station site and the remote control point, and a Local Speaker Level Control which adjusts audio level for local speaker monitoring.

These, then, are the parts that comprise remote control operation of a base station, combining serviceability and reliability along with complete capability.

Briefly, let us summarize the facts that have been presented in order to firmly place them in our minds.

First, D.C. remote control requires D.C. continuity between the control point and the base station. And the D.C. resistance must be low enough to allow our currents to reach the desired levels.

Second, control is achieved by means of D.C. current, both positive and negative, and at various levels. The commonly used levels are +10 milliamps, +5.5 milliamps, -2.5 milliamps, and -5.5 milliamps. The control signals originate at the control point and terminate at the base station.

Third, the various levels of line current are used to activate circuits designed to respond to these specific levels.

Next, these circuits at the base station are contained on module cards which plug into, and are interconnected by, a motherboard. Finally, each module contains circuits and controls which perform a specific task and work in conjunction with other modules to accomplish the desired operation.

III. SIMPLIFIED BLOCK DIAGRAMS

As service personnel, our primary concern is: How does the circuit function and, if a malfunction has occurred, how to efficiently return the unit to service. In order to achieve full understanding, let us first cover the operations in simplified block diagrams. Keep in mind as we progress through the block diagrams that each block could represent several circuits.

A. F1 TRANSMIT

Transmitting on frequency number 1 requires a line current of 5.5 milliamps. The line input is shown in the lower left hand corner of Figure 11. The line current generates a voltage which is applied to the Positive Transfer

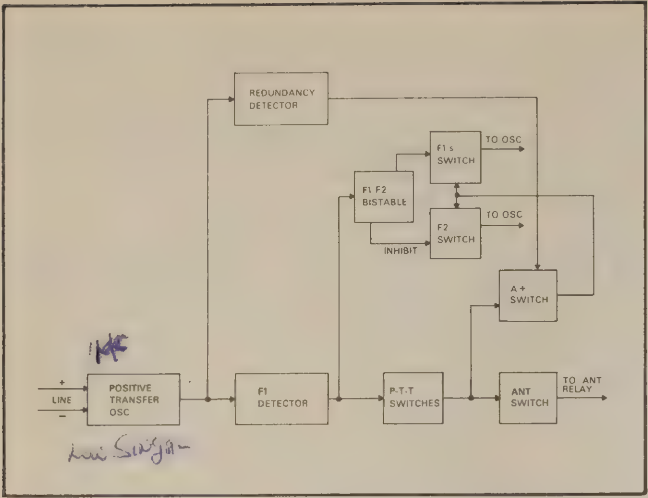


FIGURE 11. BLOCK DIAGRAM - F1 TRANSMIT

Oscillator. The oscillator produces a 1 MHz signal and feeds two circuits, the Redundancy circuit and the Push-To-Talk and F1 detector circuit. For the moment let us stay with the Push-To-Talk and F1 detector sequence.

The F1 detector has two functions. First, to set up the F1-F2 bistable into the F1 mode. The F1-F2 bistable will produce an output which will turn on the F1 switch transistor. This places a ground on the F1 oscillator. At the same time, a second output from the F1-F2 bistable will be inhibiting the F2 switch transistor. This insures transmission on the proper frequency.

The second output from the F1 detector causes the Push-To-Talk circuitry to be activated, producing a ground in its output which, in turn, is applied to two circuits. First, the antenna switch is turned on, putting a ground on the antenna relay to place it in the transmit position.

The A+ Switch will also be supplied a ground by the output of the Push-To-Talk circuit. However, if you will remember, the output of the transfer oscillator fed a Redundancy circuit as well as the F1 detector. An output from the Redundancy circuit is necessary in order for the A+ Switch to be activated by the Push-To-Talk circuit. The Redundancy circuit is a safeguard to prevent circuit failures from keying the transmitter. Also, you will notice that the output from the A+ Switch is necessary in order for either the F1 or F2 oscillator switch to be activated - further protection against accidental turn-on of the base station.

With the Antenna Switch, A+ Switch and F1 Switch circuits activated, the station would be on and ready to transmit on frequency 1.

B. F2 TRANSMIT

Our second function is transmitting on frequency 2. For this operation, a current of +10 milli-amps is required. This input is again shown in the lower left corner of Figure 12. Here,

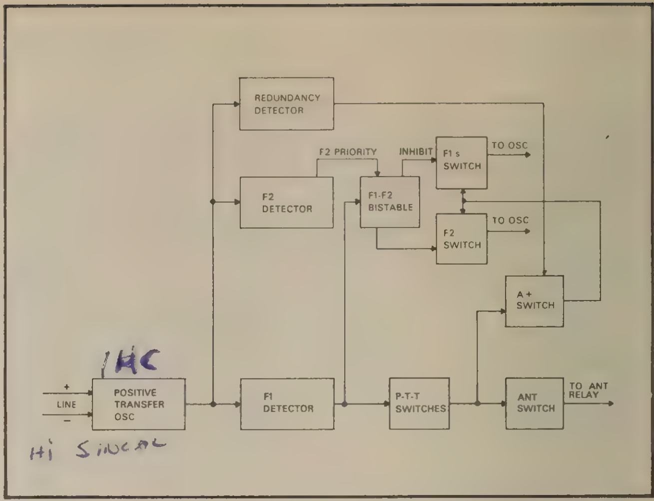


FIGURE 12. BLOCK DIAGRAM - F2 TRANSMIT

again, the transfer oscillator produces a 1 MHz signal that is applied to the Redundancy circuit and to the Push-To-Talk and F1 detector circuits. However, the signal is also fed to the F2 detector circuit. Operation of the Redundancy circuit and the F1 detector remains the same as on frequency 1 operation. However, since the higher level of line current has produced a greater amplitude signal from the transfer oscillator, the F2 detector is now activated. The F2 circuit now controls the F1-F2 bistable by means of the F2 priority lead rather than the F1 detector. This causes a ground to be applied to the F1 switch, inhibiting it. At the same time, a high level output from the F1-F2 bistable permits the F2 switch to turn on, applying a ground to the F2 channel element. The station will now transmit on frequency 2.

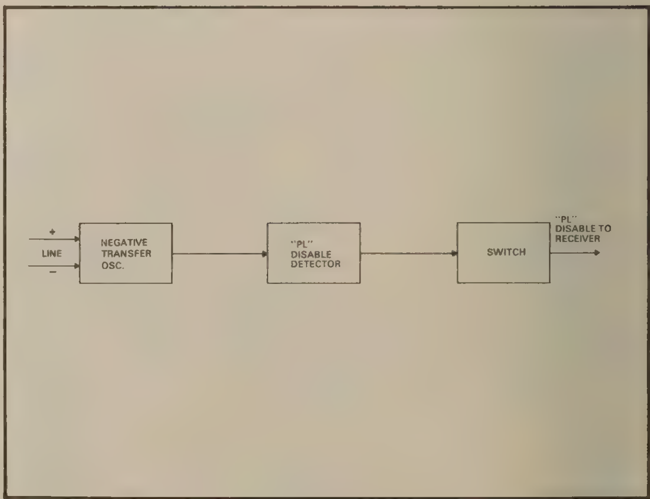


FIGURE 13. BLOCK DIAGRAM - "P. L. " DISABLE

C. "P.L." DISABLE

The third function is that of "P.L." Disable. When the remote operator wish to disable the Private Line to monitor the channel, a negative line current will be placed on the lines.

At the base station, the negative current of 2.5 milliamps produces a voltage which is applied to the Negative Transfer Oscillator. This is seen on the left side of Figure 13. The output from the transfer oscillator activates the "P.L." Disable detector, sending its output high which, in turn, causes a switch stage to operate. The output of the switch stage is a ground which is now applied to the receiver audio circuit, disabling the "Private Line" squelch. Upon removal of the -2.5 milliamps of current, all stages return to a standby state, and the receiver is once again in a "P.L." squelch condition.

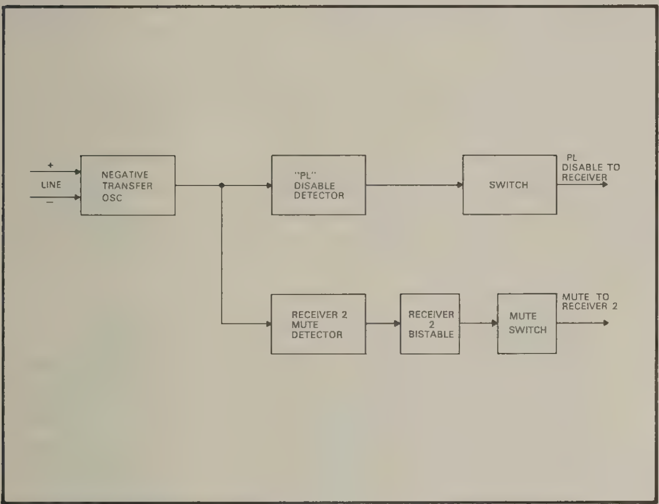


FIGURE 14. BLOCK DIAGRAM - MUTE R2

D. MUTE R2

The last of the standard functions is that of Mute R2 in stations incorporating a second receiver. Once again a negative current is utilized, but at a level of -5.5 milliamps. This level of current, being more than -2.5 milliamps, will activate the "P.L." Disable circuit. However, this will be only for the period of time that the Mute R2 switch is depressed. We see in Figure 14 that the output of the Negative Transfer Oscillator will also activate the Receiver 2 Mute detector, producing an output which is applied to a bistable. This high level output causes the bistable to change state and turn on a switch stage. This produces a switched ground output which is used to mute Receiver 2 audio. Upon removal of the line current, however, the Receiver 2 audio does not become unmuted again due to the action of the bistable. The bistable will remain in the state in which it has been placed. In order to unmute the receiver, a momentary transmission on F2 is required which resets the bistable to the unmuted state. Otherwise, on all functions, removal of the line current allows all circuits to return to the standby condition again.

Once again, let us pause momentarily to review and outline what we have learned so far about D.C. remote control from the block diagrams.

From the block diagrams, we have found that each function has its own detector which operates when the required level of line current, or a higher level, is present.

Also, each detector further activates other control circuits in order to perform the desired function.

Then it was discovered that portions of the control circuits are utilized on more than one function operation. For instance, the Push-To-Talk circuit operates on both F1 and F2 operation.

Finally, it was learned that safeguards, such as the Redundancy circuit, have been incorporated to prevent premature or undesired keying of the base station transmitter.

Remember what has been just covered, as it will all add to your complete understanding of remote control operation.

IV. LOGIC SYMBOLS

A. INTRODUCTION

Before continuing with the remote control circuits in greater detail, let us prepare by discussing the usage and meaning of logic symbols.

Logic symbols are a means of displaying on a diagram or schematic the operation and/or function of a circuit without showing the circuit components. These symbols will be encountered on the detailed functional diagram of the D.C. Remote Control system. Therefore, in order to better understand the detailed functional diagram, an understanding of logic symbols is needed.

Basically, three different logic symbols are encountered.

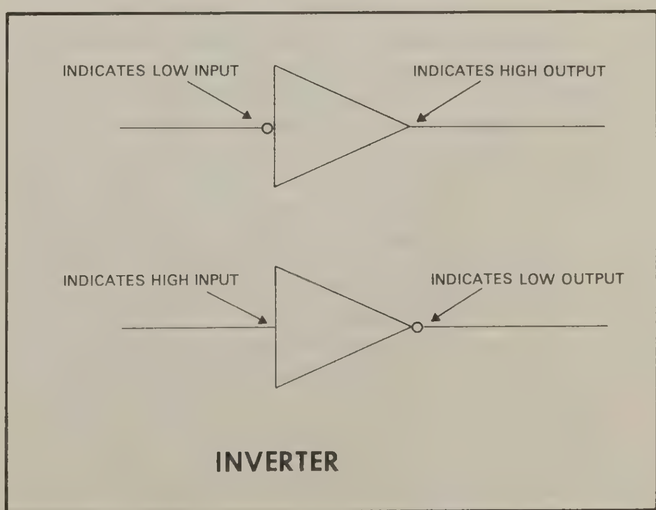


FIGURE 15. INVERTER

B. INVERTER

The first symbol that will be encountered is the symbol for an Inverter stage. the symbol used to represent an Inverter is shown in Figure 15. The Inverter stage receives an input which may be high or low and inverts it to the opposite state. A level is referred to as a high if its potential is the greater of the two voltage conditions encountered. As previously mentioned, the Inverter may have either a high or a low input, and its output will be the opposite state. The Inverter may or may not produce an amplified output. The same symbol may also be used for an amplifier stage. However, in an amplifier stage, the input and output signals are of the same state.

Whenever a level is considered to be a low, this level is indicated by means of a small circle in series with the lead connected to the stage. The inverter is primarily used to produce an input to a succeeding stage of the proper level - that is, a high or a low - as needed by the succeeding stage.

C. AND GATE

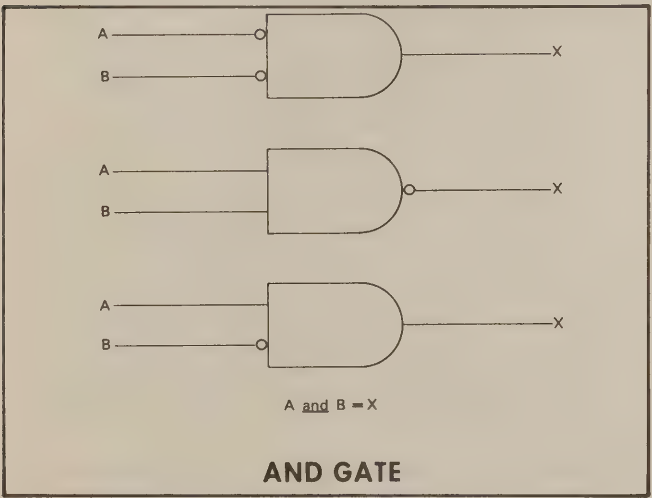


FIGURE 16. AND GATE

A second symbol encountered on the functional diagram is that of an AND Gate, as seen in Figure 16. An AND Gate is a circuit with one or more inputs that requires all inputs be of the correct level in order to achieve an output. That is, with two inputs labelled A and B, both input A <u>and</u> input B must be of the proper level to obtain the desired output from the AND Gate. Inputs may be either a high level or a low level input, and the output may be a high level or a low level, as needed. In the usual usage of an AND Gate, all inputs will be low or all inputs will be high in order to activate the AND Gate. However, in certain circumstances, there could be a possibility of having one input high while at the same time the other, or second, input is low in order to achieve the desired output from the AND Gate. As with the Inverter, a low level condition will be indicated by a small circle in series with the lead either on the input or the output of the AND Gate symbol.

D. OR GATE

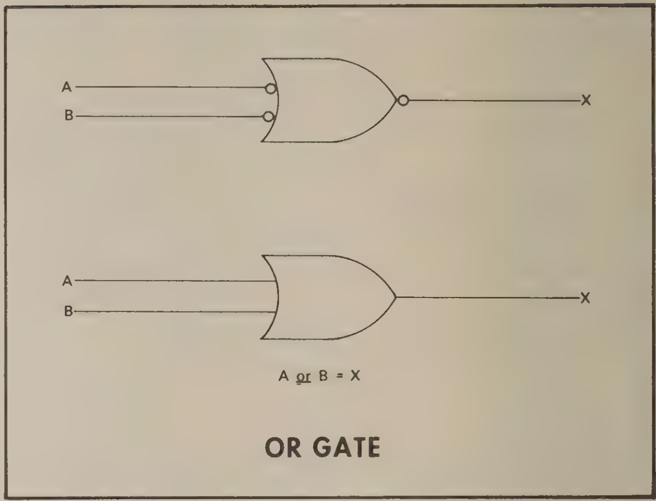


FIGURE 17. OR GATE

In Figure 17, we see a third logic symbol encountered on the detailed functional diagram - that of an OR Gate. An OR Gate has two or more inputs and a single output, the same as the AND Gate. However, where the AND Gate required that an input at A and B be present, the OR Gate merely requires that an input of the correct level be present at either input A or input B in order to produce the desired or active state in the output. Again the inputs and outputs may be either high or low as conditions require. If the level is a low, this will again be indicated by a small circle in series with the lead.

The three logic symbols just mentioned, the Inverter, the AND Gate and the OR Gate, are the only ones used on the detailed functional diagram. Other circuits, indicated by rectangles, such as transistor switches, bistables, and Schmitt Triggers, should also be understood for complete comprehension of system operation from the detailed functional diagram. The circuits just mentioned will not be discussed at this time. However, additional information is available in another section of your study guide.

V. DETAILED FUNCTIONAL BLOCK DIAGRAM ANALYSIS

A. INTRODUCTION

Now we have covered the preliminaries of D.C. operation, including simplified block diagrams of its operation and the usage of logic symbols as will be encountered in the functional diagram. Let us now cover in greater detail the exact operation of the D.C. Remote Control system.

A complete functional diagram is found in Part III-D....just after the recommended Test

Equipment and just before the sections on the individual modules. Refer to the diagram for the the detailed analysis of the system.

B. F1 TRANSMIT

Our first function is transmit on F1. Earlier we had already mentioned that transmitting on F1 requires a current of +5.5 milliamps.

1. Line Current

Starting with a simple two wire system, the current input to the Line Driver module is to pins 16 and 17 to the two halves of the line transformer secondary. Current flows through both halves of the transformer and leaves the Line Driver module on pins 14 and 18. These are marked "XMFR+" and "XFMR-". Note that since we are dealing with D.C. currents, the inputs were marked "plus line in" and "minus line in", and the outputs were marked plus and minus also. Polarity must be observed.

From the Line Driver module, the line currents now pass through the Local Control panel. The inputs are marked "DC+ and DC-" from the Line Driver. The output passes through two sections of the Line Disable switch and is marked "DC+ (switched)" and "DC-(switched)". The line current is now applied to the D.C. Transfer module. The Line Disable switch enables the serviceman to disable the base station to prevent it from being keyed remotely while he is servicing the base. Also, you will note that coming from the Line Disable switches there are three leads appearing at the bottom of the diagram. These are labelled "D.C. minus" "meter minus", and "D.C. plus/meter plus". These leads are connected to connector J9, and from there to the junction box and terminal boards in the junction box on the base station.

2. F1 P-T-T Sequence

Current from the Local Control panel now arrives at the D.C. Transfer module on the left at terminal 3 and 4. The current will generate a voltage which is applied to both the Positive and Negative Transfer Oscillators. However, it will be of the correct polarity to activate only the Positive Transfer Oscillator. Once voltage is applied to the Positive Transfer Oscillator, it will produce a 1 MHz signal output. The signal is applied to the Push-To-Talk and F1 detector, the F2 detector and the Redundancy detector. At this time let us just consider the Push-To-Talk and F1 detector. The A.C. signal will now be detected by the F1 detector and produce a positive going output. The positive output is applied to a Schmitt Trigger, Q21 and Q22, and to the F1-F2 bistable, Q8 and Q9. Again, since we have two paths, let us stay with one path through its completion. The Schmitt Trigger, upon receipt of a positive going input, will produce an output voltage which is also positive going. The output of the Schmitt Trigger is applied to the Line Push-To-Talk Switch, Q23. The positive going input to Q23 will cause its output to go low. This low is the Push-To-Talk ground which will now be applied to the Station Logic circuitry.

Before going to the Station Logic circuits, notice that in the lower left hand corner of the D.C. Transfer module we have a circuit known as the Bias Generator. It is indicated as receiving A+ voltage, and generates voltages through a voltage divider network. These are labelled "A", "B" and "C". This is the bias voltage that will be applied to the various detector circuits and will establish the level necessary to activate that detector. Notice that other detectors were not activated at this time due to a difference in the bias voltage. We will find later that the voltage being generated and applied to the other detectors will, in conjunction with the level of input signal, determine whether or not th detectors are activated.

3. Local Mike and P-T-T Circuit

The Push-To-Talk ground from the D.C. Transfer module is applied to the Push-To-Talk OR Gate number one and to the Local Mike Inhibit circuit. For the moment, let us talk about the Local Mike Inhibit switch. You will notice that it has two inputs, with the second or lower input being exciter ground. This exciter ground is applied from the exciter circuitry in the transmitter through the connectors and is a permanent ground. With the two inputs now being low, conditions are satisfied for the AND Gate, which is used as the Local Mike Inhibit switch. Its output will be activated. With both inputs going low, the output will be a high level signal. As the output of the Local Mike Inhibit switch goes high, the microphone audio ground is removed from the local microphone circuit, thus preventing the local microphone from being operational. This means that the remote control operation has precedence over local operation of the base station. A person trying to transmit locally would not be able to transmit once the base station is keyed remotely.

Going back to the Push-To-Talk OR Gate number one, we find it requires only one input to be activated. In this case, we have satisfied this condition and the Or Gate is now activated. Its output will go low. The low, or ground, output of the Push-To-Talk OR Gate number one is now applied to the Push-To-Talk OR Gate number two. Again, requirements are satisfied and the output of the Push-To-Talk OR Gate number two will also go low.

This low is applied to the Push-To-Talk Inverter. Remember from the section on logic symbols that the Inverter will take the level of input and invert it to the opposite state. Thus, the output of the Push-To-Talk Inverter will be a high level signal. The high is applied in two paths. One, to the Switched A+ driver, Q5; the other to the Antenna Relay/Receiver Mute switch, Q6. The high level signal to the Switched A+ driver, Q5, is all that is needed to supply or derive an output from the driver stage. However, before continuing on, let us go back to the D.C. Transfer to examine a second circuit.

4. Redundancy Circuit

If you will remember, once the line current has caused the Positive Transfer Oscillator to be activated and produce an output, we had supplied a 1 MHz signal to not only the Push-To-Talk and F1 detector, but also to the Redundancy detector. The detector produces an output which is positive going. This high level signal is applied to an OR Gate which is the Redundancy OR Switch Driver. Input conditions are either a high from the Redundancy detector or a low on the second input. Since a high is being supplied, the Switch Driver would now be activated. When it is activated, its output is going to go low - and is applied to the Redundancy switch, Q19. The Redundancy switch, activated by the low input, produces a high level output which is applied to the Station Logic as an input to the A+ Switch circuit.

5. A+ Switch Circuit

Once more, as we examine the Station Logic module, we have already activated our Push-To-Talk Inverter and a high level signal is being applied to the Switched A+ driver. This circuit is activated and produces a low level output. This supplies a low level input into the A+ Switch. At the same time, from the D.C. Transfer module, we are receiving a high level Redundancy signal. This also is being applied to the A+ Switch Q7. The A+ Switch is an AND Gate and requires both a high level and a low level input in order to be activated. As you can see, these conditions have been met at this time, and the A+ Switch will activate, producing in its output a high level signal. The output of the A+ Switch, is applied to the left, back to the D.C. Transfer module, where it is applied to the oscillator circuitry. The output is also being applied to the right where it will proceed to the connectors and from the connectors be applied to the power supply for the purpose of keying the power supply. Since we have already mentioned that the output of the A+ Switch, or in other words, Switched A+, is applied back to the D.C. Transfer module, let us go to that module and examine the action at this time.

6. F1 Oscillator Circuit

Now we see the action that occurs in the oscillator circuitry. When the line current was first applied, and the F1 detector was activated, its high level output was not only applied to the Schmitt Trigger, but also to the F1-F2 bistable. However, we could not activate the oscillator circuitry at this time since it was required that Switched A+ be provided. Once the Switched A+ is provided, it is applied to the F1 and F2 inhibit gates. When they are activated they will feed their outputs to the F1-F2 switches. In order to activate the channel element in our transmitter, we need an oscillator ground. In this situation, where we are keying on F1, the F1 switch is now activated and its output has gone low. This low is the oscillator ground and will be applied to the channel elements in the transmitter. At the same time, you will notice that the output of the F1-F2 bistable has also activated the F2 inhibit gate which is now producing a low to inhibit the F2 switch and prevent it from being turned on.

7. Antenna Relay Circuit

By this time, circuitry has been activated to provide us with Switched A+ used to key the PA power supply, to provide a ground for the oscillator circuits, and to inhibit the local microphone. Also the output of the Push-To-Talk Inverter was applied to the Antenna Relay/Receiver Mute switch, Q6. This circuit will be activated by the high level input and produce a ground which will be applied to the antenna relay. This will allow the antenna relay to be activated and connect the antenna to the output of the transmitter. It will also supply an output which will be used to mute the receiver audio. In addition, the same output will be supplied to the Line Driver module to activate the Line Driver switch stage.

At this time, the transmitter would now be on the air, transmitting on frequency one. Before continuing, one further item should be noted; that is, that since the Switched A+ driver and the Antenna Relay/Receiver Mute switch were supplied with inputs at the same time, the antenna relay will actually be activated before the transmitter channel elements are provided a ground. This will allow the antenna relay to be switched dry, or without RF power, thus extending the life of the antenna relay contacts.

8. Line Driver Switch Circuit

The output of the Antenna Relay/Receiver Mute switch on the Station Logic module is applied back to the Line Driver module. This low level input is applied as an audio disable signal to the Line Driver switch, Q8. This will cause the output of the Line Driver switch to go to a high level which

will deactivate or inhibit the line driver circuit. This will prevent any random noise in the amplifiers from being coupled through the transformer into the transmitter audio circuits and being transmitted.

9. Exciter Audio Circuit

The remote control lines connecting the control point to the base station are used not only for D.C. currents, but also for audio. Audio coming in to the base station enters the Line Driver module as shown on leads 16 and 17. The audio is coupled through the transformer to a winding on the input of the Exciter/Speaker amplifier, Q9. The audio signal is amplified and will be applied to the Station Logic and to the Local Speaker in the base station. The Local Speaker Level Control will allow adjusting of the amounts of volume obtained in the Local Speaker.

Audio from the Line Driver module is now applied to the Exciter Level Control in the Station Logic module. This control will enable us to set the proper parameters for feeding signals into the Paraphase amplifier and then to the Exciter Audio amplifier. The output of the Exciter Audio amplifier will be applied to the Exciter Audio circuit in the transmitter and will be used to modulate the transmitter to produce the correct amount of deviation. Thus, the transmitter is now on the air and being modulated by audio. As we can see, proper operation of the transmitter on frequency one requires not only setting line currents properly, but also correct adjustment of the Exciter Level Control and the correct setting of the IDC in the transmitter. If all levels are set properly, optimum operation of the system will be the result.

C. F1 TURN OFF

When the line currents are removed from our remote control lines, the circuits in the base station control chassis will revert to a standby state. The circuits were all activated as a result of the line current being placed on the line. Therefore, once they are removed, the signals needed to keep our circuits activated are no longer present. The F1 detector and the Redundancy detector will both be turned off allowing their outputs to go low. Since the output of the F1 detector is low, the Schmitt Trigger will also be allowed to revert to its quiescent, or normal, state of operation. Its output is also low. With the input of the Line Push-To-Talk switch being low, its output will, at this time, go high, removing Push-To-Talk ground, which had been applied to the Station Logic module. The Redundancy detector, producing a low output now, will not be satisfying conditions that are required for the Redundancy OR Switch Driver, Q18. As a result, its output will go high at this time. The Redundancy switch, since it will see a high, will now produce a low. This would remove the high level signal required as an input to the Station Logic module. The Station Logic module would not be providing the oscillator circuitry a switched A+ at this time. Therefore, this line will also go low. Without the switched A+ input, the F1 inhibit gate can no longer function, and this will cause the output of both the F1 and the F2 switches, Q12 and Q13, to go high, removing the oscillator ground. One circuit will remain in the condition in which it was activated, even though its input has changed. This is the F1-F2 bistable. Although its input has now gone low, it will not revert back to another state. It will remain in the condition in which it had been placed. Because it is a bistable, it will retain one state until it is forced into the other state. Since no signal has been applied to force it into a second state, it will remain in the F1 state.

With the Push-To-Talk ground from the D.C. Transfer module removed, the input to the Station Logic module will be high. This will cause the Local Mike Inhibit switch to produce a low level output again, since conditions for an AND Gate are not being met, applying a ground to the local microphone. This will enable local operation of the base station. The Push-To-Talk OR Gate number one, with a high level input, will be producing a high level output. This high level output will cause the Push-To-Talk OR Gate number two to also produce a high level output. With a high level input to the Push-To-Talk Inverter, its output will now become low. This low is applied to both the Switched A+ driver and to the Antenna/Relay Receiver Mute switch. The output of the Antenna Relay will be a high at this time, removing the ground from the antenna relay allowing it to revert to the receiver position. The Switched A+ driver will also produce a high level output which is applied to the A+ Switch transistor. The other input to the A+ Switch is the Redundancy input, is a low coming from the D.C. Transfer module. This will cause the A+ Switch transistor, Q7, to produce a low output instead of the A+ output that is required for transmitting.

At this time, then, all circuits will have reverted back to a standby state, waiting again for the next activation by means of line current, and the transmitter is off the air since all circuits have returned to their original condition. Again, remember, in order to activate on transmitter frequency number one, a current of 5.5 milliamps would be applied.

D. F2 TRANSMIT

Let us now examine the functions that will occur when we transmit on frequency number two. If you will remember, earlier we stated that for frequency number two a line current of +10 milliamps is required. When +10 milliamps of current is applied, the path will be applied through the Line Driver module and the Local Control panel, exactly the same as on

frequency number one. However, when the +10 milliamps of current is applied to the Positive Transfer Oscillator, a higher output level of 1 MHz Signal will be generated. This higher level is applied again to the Push-To-Talk and F1 detector, to the Redundancy detector, and also to the F2 detector. Since it is greater than the 5.5 milliamps, the F1 detector will again be activated, the Redundancy detector will be activated, and at this time sufficient voltage will have been generated to activate the F2 detector. If we look again into the lower left hand corner of the D.C.

Transfer module, we will notice the Bias Generator. The voltages generated by the Bias Generator being applied to the various detectors will establish a level which will determine when the detectors are to be activated. In this instance, the level of signal voltage generated will be sufficient to overcome the bias on the F2 detector and, therefore, it will be activated.

Going back to the F2 detector, we find that when it is activated, or in other words, when it recognizes there is a signal on the line, it will produce a positive going voltage. This positive going voltage is applied to the F2 bistable, Q6 and Q7. The F2 bistable will be activated by the positive input level as long as switched A+ is available and will turn on. When the F2 bistable turns on, an output from the F2 bistable, called the F2 priority, will be applied to the F1-F2 bistable. When we transmitted on frequency number one, the F1-F2 bistable was activated by an output from the F1 detector. Now the output from the F2 bistable will assume priority over the output from the F1 detector. This will cause the F1-F2 bistable to be activated in a state exactly opposite to its condition for F1 transmit operation. That is, the output going to the F2 inhibit gate will now be low and the output to the F1 inhibit gate will now be a high level signal. This will cause the output of the F1 inhibit gate to go low which will, in turn, inhibit the F1 switch, causing its output to stay at a high level. The F2 inhibit gate, on the other hand, will have its output go high which will allow the F2 switch to turn on, producing a low for the oscillator ground. This will allow the F1 channel element to be inhibited and the F2 channel element to be placed in operation. All other circuits in the D.C. Transfer module that were activated for F1 operation will also be activated for F2 operation. In fact, all the circuits in the Station Logic module activate exactly the same for F2 or F1 operation. The station would now be ready to transmit on frequency number two.

Turn-off for frequency number two would occur exactly as for frequency number one except that now the F1-F2 bistable will remain in the F2 position. Since it is a bistable, it will remain in the position it has been placed until another signal causes it to change states. However, the F2 bistable would not remain in its F2 condition since it requires an input of Switched A+ in order to be activated. Once the station turns off, switched A+ is no longer available and the F2 bistable must be activated again in order for it to produce its F2 priority output.

E. "P.L." DISABLE

We have now discussed the two most commonly used functions - transmitting on frequency one and transmitting on frequency two. Two other functions are available, the first of which is "P.L." Disable. Let us examine the circuits to see what happens during an operation of "P.L." Disable

1. Negative Line Current

Again the Line Driver module will be receiving line current. However, in this case, the line current is in the reverse or negative direction. That is, the top side is now the minus side of the line and the bottom side of the transformer is the plus side of the line. Line current will then pass through the line transformer in the opposite direction and be applied again to the Local Control panel.

The operation of the Local Control panel will remain the same as for positive line current, with the exception, of course, that the line current is passing through the Line Disable switches in the opposite direction. However, this will not effect any operation - we will still be able to disable the line if needed so that the station cannot be activated remotely. The line current output, both minus and plus, will again be applied to the D.C. Transfer module, as in the case of positive current operation.

2. "P.L." Disable Sequence

The current is once again being applied to the Transfer Oscillators, both the positive and negative. However, since the current is in a negative direction, only the Negative Transfer Oscillator will have voltage applied to it that will allow it to be activated. The Negative Transfer Oscillator will produce a 1 MHz signal which is then applied in two locations: to the "P.L." Disable detector and to the Receiver Number Two Mute detector. Remember that the current applied on the line at this time is a minus 2.5 milliamps. This will generate a level of 1 MHz signal out of the Transfer Oscillator that will be able to override the bias for only the "P.L." Disable detector. Again we can note the Bias Generator located in the lower left hand corner of the D.C. Transfer module and the fact that the bias voltage generated to be applied to the "P.L." Disable detector is the A bias. This will cause the "P.L." Disable detector to be biased in such a manner that the 1 MHz signal out of the Negative Transfer Oscillator will be able to activate the "P.L." Disable detec-

tor. However, the Receiver Number Two Mute detector will be biased to a point that the signal cannot activate this detector. The "P.L." Disable detector's output will go high at this time, or in a positive direction and is applied to the Switch transistor, Q25. With a high input signal arriving at the Switch transistor, the transistor will turn on and its output will go low. The output of the Switch transistor, Q25, is then applied as switched ground to the receiver squelch circuits where it will disable the "Private-Line" portion of the squelch, allowing the receiver to revert to carrier squelch operation. With the receiver in carrier squelch operation, the operator will be able to determine if another station is operating on the same frequency or channel prior to his transmission. If he does not detect the presence of a carrier on the air, he will know that he may transmit at that particular time. When the operator has determined that no one is transmitting on his channel, he will release his "P.L." Disable switch which will remove the -2.5 milliamps of current from the line. At this time the Negative Transfer Oscillator will turn off, eliminating the 1 MHz output. The "P.L." Disable detector will relax back to its standby state with a low output which will allow the switch transistor to again produce a high level output. The "P.L." in the receiver will no longer be disabled. This circuit, then, allows the receiver to be disabled from "P.L." operation in order to monitor the channel, but automatically returns it to "P.L." operation once the "P.L." Disable switch is deactivated.

F. MUTE R2

The second of the two options utilizing minus current is Receiver Number Two Mute. This option enables a receiver to be muted in order to listen more closely to a message being received on the number one receiver. This, of course, would only be available on a two receiver unit.

1. Mute R2 Sequence

To activate the function of Mute Receiver Number Two, a line current of -5.5 milliamps is applied to the line, then to the Line Driver module and through the Local Control panel, the same as was accomplished for "P. L." Disable operation. The current then arrives at the D. C. Transfer module. Again, the current will activate only the Negative Transfer Oscillator, producing a 1 MHz signal, but of a greater amplitude that of the "P. L." Disable signal. The output is applied to both the "P. L." Disable detector and the Receiver Number Two Mute detector. However, in this case, the amount of signal generated from the Transfer Oscillator will be sufficient to overcome the bias on both the " P. L." Disable detector and the Receiver Number Two Mute detector. Both circuits will, therefore, be activated. When these circuits are activated, they will produce a high level output. Let us first follow the case of the Receiver Number Two Mute detector. When its output goes high, that will apply a high level signal to the Receiver Number Two Bistable. The bistable, Q2 and Q3, will be activated and it, in turn, will produce a high level output. This high level output is applied to the Receiver Two Mute switch, Q4. When the mute switch receives a high level input, it will activate, producing a low level, or switched ground, output. This switched ground output is applied to the receiver which will mute the audio circuit. With the options that are available, it is possible to completely mute the receiver or to mute it by set amounts of attenuation - 10, 20, or 30 DB. The amount of the attenuation, either complete mute or 10, 20, or 30 DB attenuation, would be set up for the desired system operation. Thus, the operator will be able to listen to any important messages on receiver number one, without interference by a message coming in on Receiver number two.

Beside muting Receiver number two, we will also "P. L." Disable. Since our line current was a -5.5 milliamps, the "P. L." Disable circuitry will also be activated. We will again obtain a switched ground output from the Switch transistor, Q25, which would be applied to Receiver number one, disabling the "P. L." in that receiver. This "P. L." disabling, however, would only be momentary during the time that the Receiver Two Mute switch was being pressed.

Once the Receiver Mute switch is released, the line current of -5.5 milliamps is removed from the lines. Again, this would allow the Negative Transfer Oscillator to turn off, eliminating its 1 MHz output. With no input, the detectors will now revert to their standby state. Both detectors will produce a low level output at this time. The "P. L." Disable switch, Q25, would again produce a high level output, placing Receiver number one in "P. L." condition. However, you will notice that a bistable is used in the Mute Receiver Two circuit. The Mute Receiver Two Bistable will not reset. It will stay in the mute condition. Therefore, Receiver number two will continue to be muted, even though the line current has been removed. Another operation is required in order to unmute Receiver number two.

2. Mute R2 Reset

Unmuting of Receiver number two requires a momentary transmission on frequency two. This means placing a

10 milliamp current in the positive direction on the control lines. This is applied through the Line Driver module, through the Local Control panel, and to the D. C. Transfer module. The line current arriving at the D. C. Transfer module will cause a voltage to be applied which will activate the Positive Transfer Oscillator. The oscillator will produce an output, and there will be a momentary transmission on frequency two. However, the circuit we are primarily concerned with is the F2 detector. The F2 detector will be activated, along with the other detectors, and the F2 detector will produce a high level output. This will be applied to the F2 bistable which, in turn, will produce a low level output. This low level is applied to the Receiver Number Two Bistable. This is the reset signal for the Receiver Two Bistable. Upon receipt of a low level signal, the bistable will revert back to its standby state and produce a low level output which is applied to the Receiver Number Two Mute switch, Q4. This allows the stage to produce a high level output which will allow the receiver audio to be unmuted in Receiver Number Two.

At this time, Receiver Number Two will be capable of receiving any signals on its channel.

We have now covered all four standard options, or functions, available with D. C. Remote Control. One other small portion remains to be covered. That is the Local Control panel, itself.

G. LOCAL CONTROL

Local control will allow us to perform certain functions at the base station, itself.

There are three switches and a connector located on the Local Control panel. One of these switches we have already discussed - the Line Disable switch which enables us to interrupt the lines to prevent a function from being activated while we are at the base station doing maintenance. There has also been a reference to the Microphone Jack. Let us take a closer look at the circuit of the Microphone Jack as well as the Transmit switch and the "P. L." Disable switch. This is located in the upper right hand corner of the diagram.

Let us first discuss the Transmit switch. You will notice the lead on the left is marked "ground". By pressing the Transmit switch we would then be applying a ground to the microphone. This ground would not only be applied to the microphone, but would also be used as the local Push-To-Talk line. The local Push-To-Talk line would activate the exciter exactly as if we had operated the Remote Control Console to transmit on a frequency. That is, it will activate circuits in order to turn on the correct channel element, to provide switched A+ and to switch the antenna relay into the transmit mode of operation. At the same time, the microphone audio circuit would be activated to provide audio from pin 1 of the Microphone Jack to the transmitter audio circuit. Thus, a person may be able to operate the station locally by pressing the transmit button on the control panel or by activating the microphone Push-To-Talk button and speaking into the microphone.

A final switch is the "P. L." Disable switch. You will notice that A+ is normally applied from the lead on the right which would then be applied on the lead marked "P. L." Disable (Switched ground). However, if it is desired to "P. L." disable locally, by pressing the switch, a ground can be picked up from the lead at the left and apply it as switched ground. The switched ground, of course, would have preference over the A+, due to the isolating resistor that is contained in the Local Control panel. This would again "P. L." disable the receiver by removing the "P. L." operation from the receiver. This allows the receiver to revert to carrier squelch operation to determine if a transmission is occurring on that channel.

All functions, both local and remote, have now been covered. A certain degree of familiarity with the system operation of D. C. Remote Control should have been achieved.

PART III-B. SERVICING PROCEDURES

Two methods of servicing the base station modules will be mentioned here. This does not mean that other methods may not be used. In fact, the more methods a technician has for approaching a problem, the more efficient the servicing becomes.

When servicing base station modules at the base station site, a TLN8799A Extension Board allows access to all points of the circuit while maintaining the module in an operational state. Figure 18 shows a Station Logic module being serviced using the TLN6799A Extension Board.

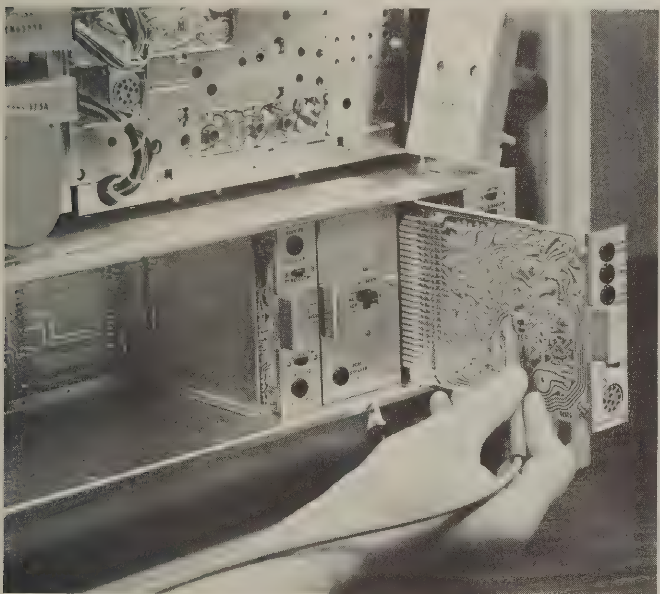


FIGURE 18. SERVICING USING TLN8799A EXTENSION BOARD

The TEK-38 Base Station Module Servicing Adapter in Figure 19 provides the Service Technician a convenient means of troubleshooting and repairing any Base Station Remote Control Circuit Module away from the station site. The adapter eliminates the need for the base station as a source of power and actuating signals for module servicing.

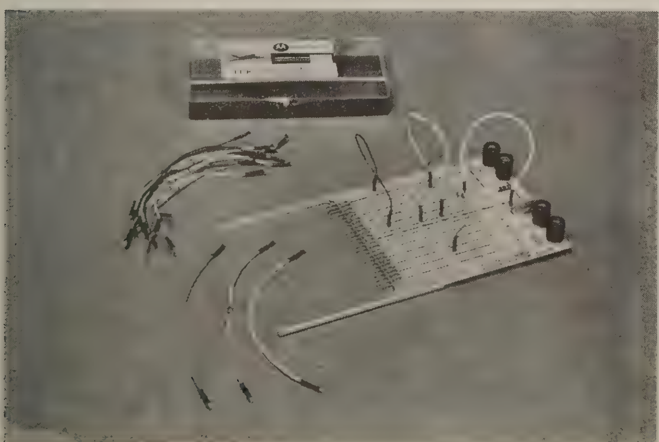


FIGURE 19. TEK-38 BASE STATION MODULE SERVICING ADAPTOR

The TEK-38 is easy to use and will accommodate all control modules used in Upright Base and Compa-Stations from low band through 450 MHz and into 960 MHz. The circuit module is simply "plugged in" to the 24 pin male plug.

Figure 20 shows a bench setup for servicing the Station Logic module. Necessary connections are made by following the "Out of Circuit Servicing Chart" located in each Base Station Module Manual Section. The connections, themselves, are made to the circuit module via the TEK-38 adapter by the use of push-on patch leads and patch pins on the TEK-38. Each module connection has at least three patch pins. For multiple connections, A+ and ground have six patch pins since they are used frequently.

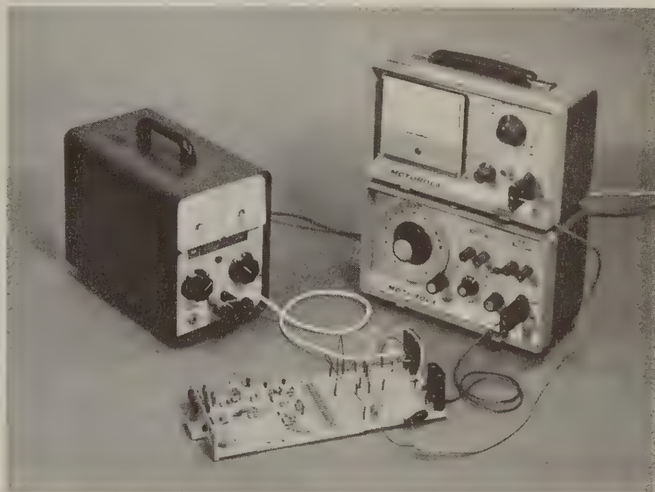


FIGURE 20. BENCH SETUP FOR SERVICING STATION LOGIC MODULE

NOTE

It is not necessary to push the connector completely onto the pin. Connector life will be extended and installation simplified if the patch leads are pushed on just until the detent is engaged.

The patch lead kit supplied with the TEK-38 contains six red, six black, and six white leads. Also supplied are six 10 K ohm and two 100 K ohm resistor patch leads. The leads are attached by means of the push-on connector. Typically, the red leads can be used for A+ connections, black leads for ground connections, and white for "other" purposes (8.8 V, audio, etc.). In a pinch, Minigator clip leads make good substitutes for patch leads.

A+ is supplied to the module via the double banana connector supplied for that purpose. A small bench power supply such as the Motorola TEK-23, Figure 20, is suitable for this purpose.

An 8.8 V source is provided for those modules using this voltage such as the D.C. Transfer module in D.C. systems, and the F1 and F2 modules in Tone systems. The voltage source should be used in place of the voltage divider indicated on the individual module service instructions.

A connector is provided for module audio input. See Figure 20 and 21. The audio may be coupled either directly or through a capacitor, as required, to any pin by a patch lead. An ideal audio source is the Motorola S1067A Audio Oscillator.

By following the service procedures outlined in each module section, most problems can be quickly and efficiently isolated.

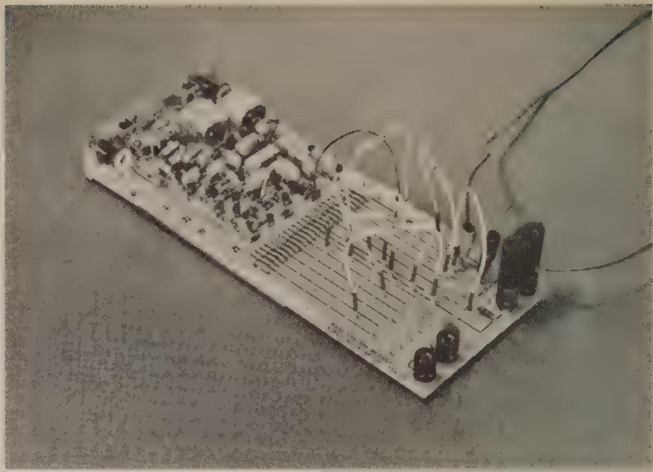
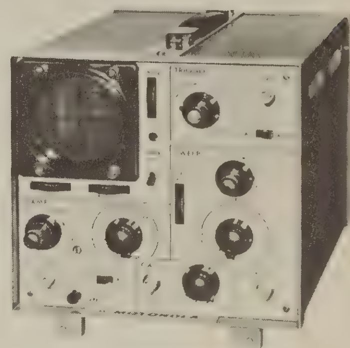


FIGURE 21. SERVICING THE D. C. TRANSFER MODULE

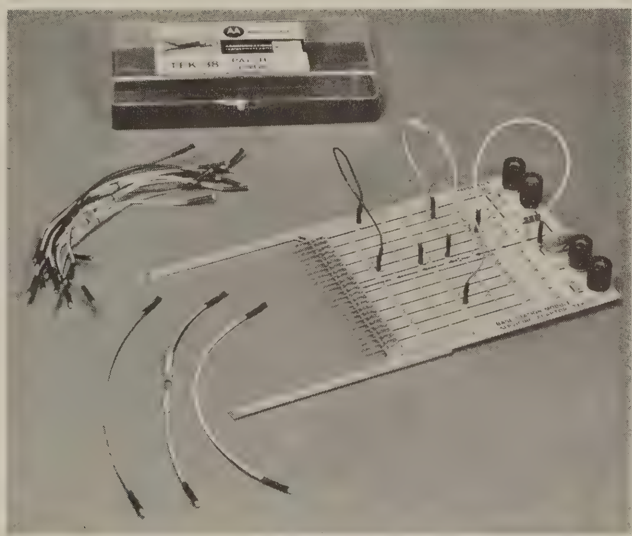
RECOMMENDED TEST EQUIPMENT

S1063A DC Multmeter

TEK-23 Power Supply



S1301A Oscilloscope

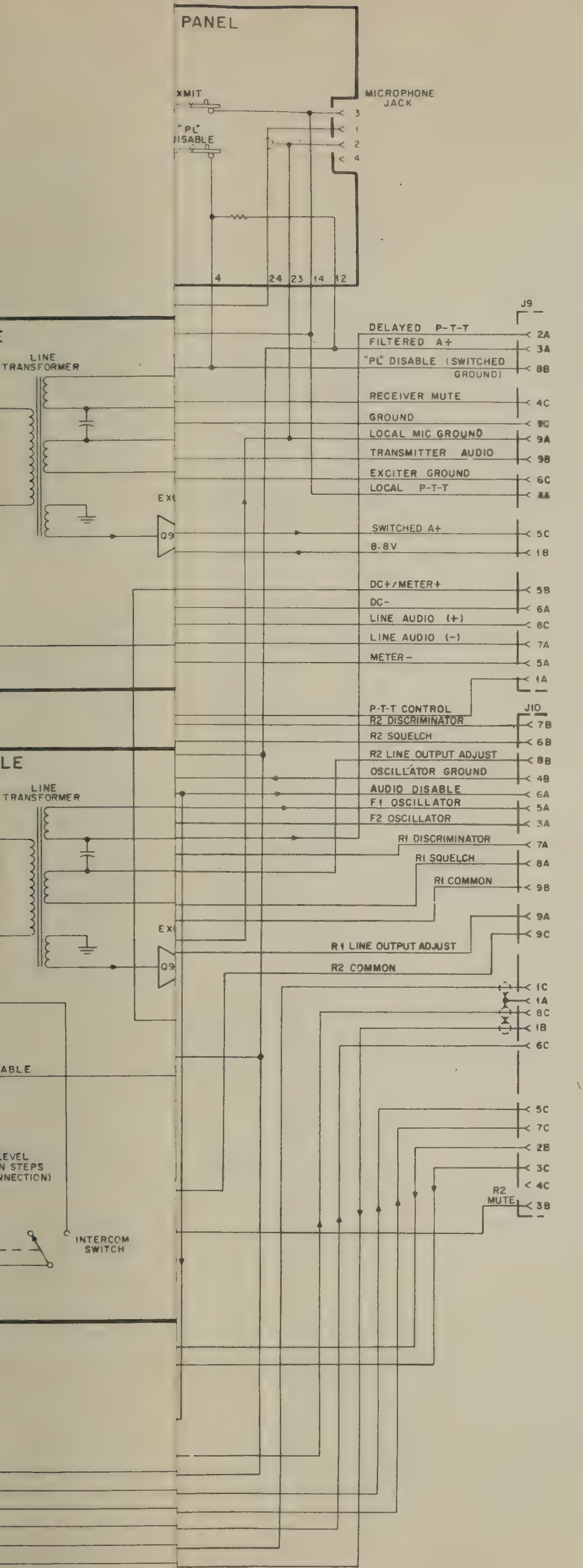


TEK-38 Base Station Module Servicing Adapter

S1078C Digital Frequency Meter With Deviation Monitor

S1051C AC Voltmeter

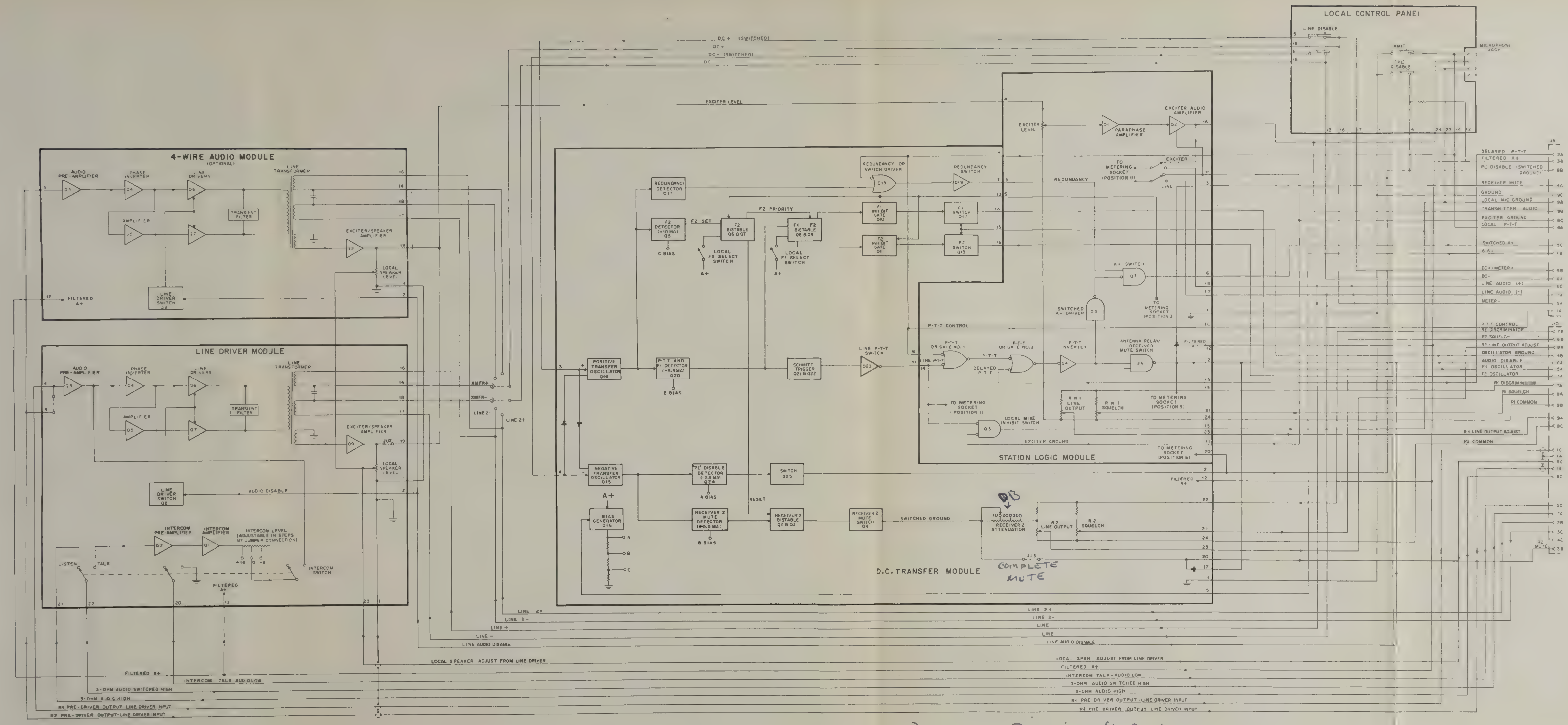
S1067A Audio Oscillator



DETAILED FUNCTIONAL DIAGRAM
D.C. REMOTE CONTROL

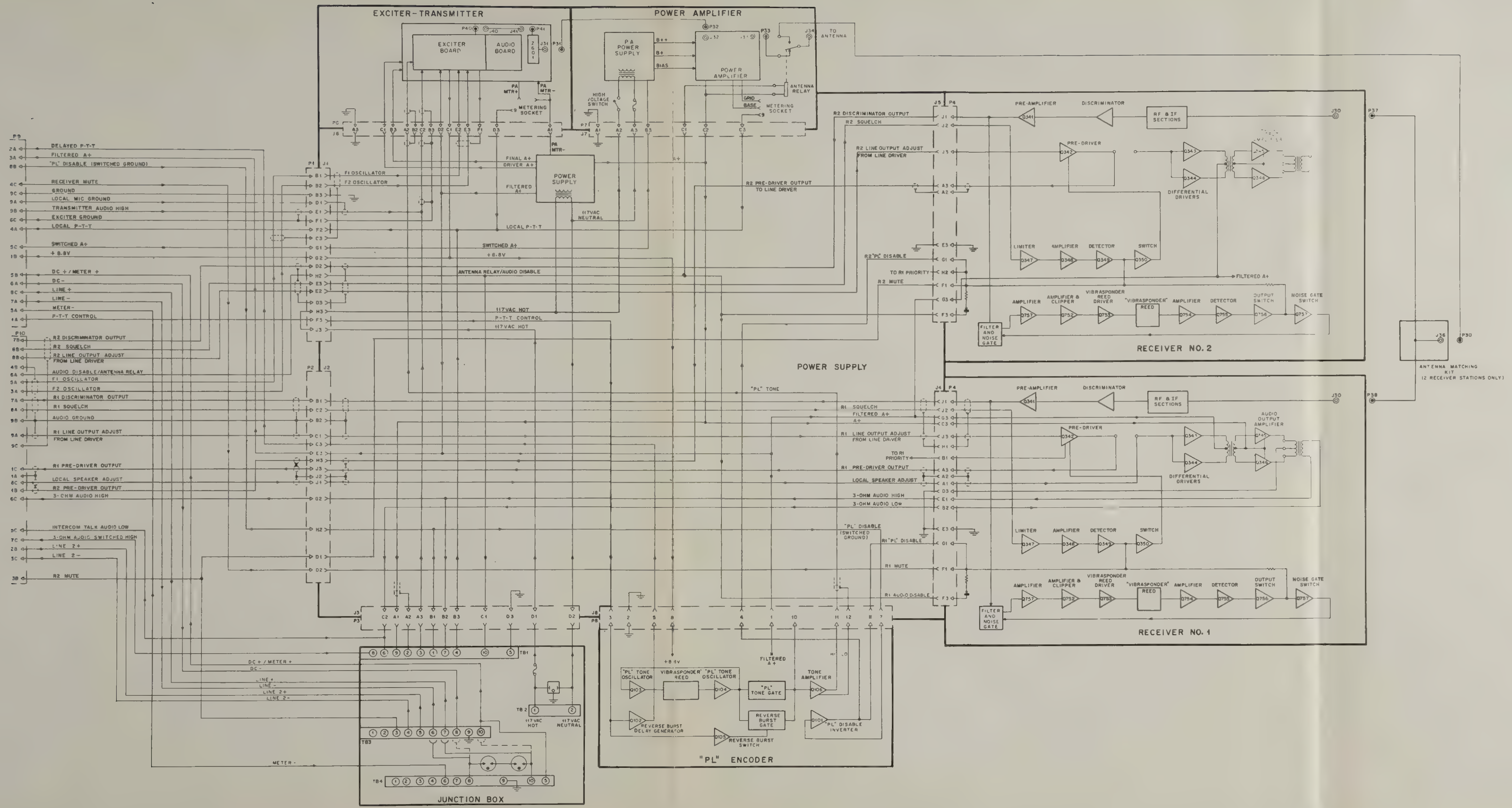
SHEET 1 OF 2

D.C. INTERCONNECT BOARD



Remote has Priority over Local Control

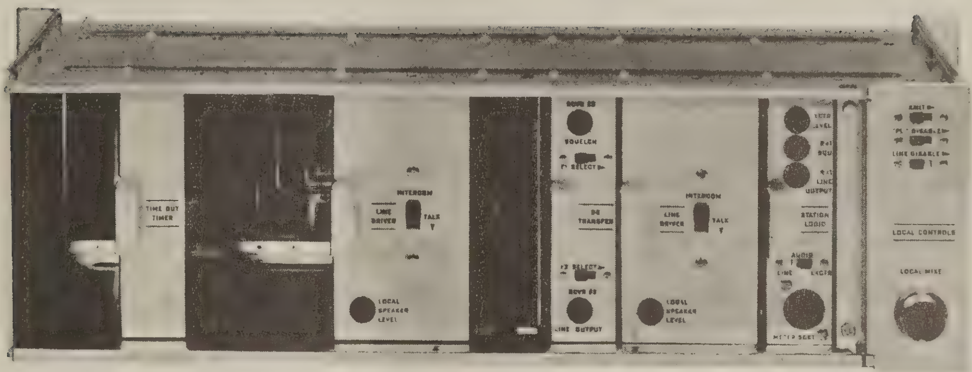
DETAILED FUNCTIONAL DIAGRAM
D.C. REMOTE CONTROL
SHEET 1 OF 2



DETAILED FUNCTIONAL DIAGRAM
D.C. REMOTE CONTROL
SHEET 2 OF 2

DC REMOTE CONTROL CHASSIS

TCN1058A



1. APPLICATION

a. DC Remote Control

This chassis, together with the associated plug-in modules, permits the station to be operated from a remote location and performs various control or operational functions for the station. DC line currents generated at a remote location(s) are carried over wire lines to the station remote control chassis to implement the desired type of operation. The remote control chassis and its modules convert the dc line currents into switching functions to perform any or all of the following operations depending on the modules used:

DC LINE CURRENT (MA)	OPERATION
+5.5	Turn-on transmitter F1 oscillator
+10.0	Turn-on transmitter F2 oscillator
+10.0 (momentary)	Unmute receiver #2

DC LINE CURRENT (MA)	OPERATION
0	Transmitter standby, receiver operative
-2.5	"PL" Disable (receiver)
-5.5	Mute receiver #2 audio

b. Plug-In Modules

Refer to the pertinent module sections of this manual for theory of operation and circuit description.

(1) Station Logic Module

This module provides sequencing, timing, and control functions for remote operation of the station. It also amplifies line audio to the proper level for the exciter. The following switches and controls are included:

- XCTR LEVEL control -- sets audio input to exciter

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- R1 LINE OUTPUT control -- sets line output level
- R1 SQU control -- adjust receiver #1 squelch sensitivity
- LINE-XCTR AUDIO switch -- selects exciter or line audio level measurements at the metering socket
- METER SCKT -- permits the serviceman to connect a Motorola Portable Test Set for servicing the remote control unit.

(2) DC Transfer Module

This module converts dc line currents into control functions for remote station operation. The following controls are included:

- F1 SELECT, F2 SELECT switches -- permit manual selection of station operating frequency.
- R2 SQU control -- adjusts receiver #2 squelch sensitivity
- R2 LINE OUTPUT -- sets receiver #2 line output level

(3) Line Driver Module

This module amplifies and routes received audio to the remote control location and couples transmit audio from the remote control site to the transmitter. The following controls are included:

- INTERCOM switch -- permits intercom operation between the station site and remote control point(s).
- LOCAL SPKR LEVEL control -- permits adjustment of the audio level for local speaker monitoring.

(4) Squelch Gate Module

The squelch gate module generates switched dc voltages for transmitter "turn-on". This module also performs the following functions:

- Local push-to-talk
- Enables the delayed dropout time generator
- Inhibits R1 mute switch
- Starts the time-out timer (optional)

c. Optional Modules

(1) Time-Out Timer Module

The time-out timer module prevents continuous transmission or repeater "lock-up". The timer can be preset for 1/2, 1, 2, 4, or 8 minute operation.

(2) 4-Wire Audio Module

When the station is equipped for 4-wire audio operation, two separate audio pairs can be used. A variety of operational options can be used by proper jumper and line connections.

(3) Single-Tone Decoder

The single-tone decoder module requires that a tone burst of a specific frequency precede an incoming message for selective signalling. Refer to the SINGLE-TONE DECODER section for additional information.

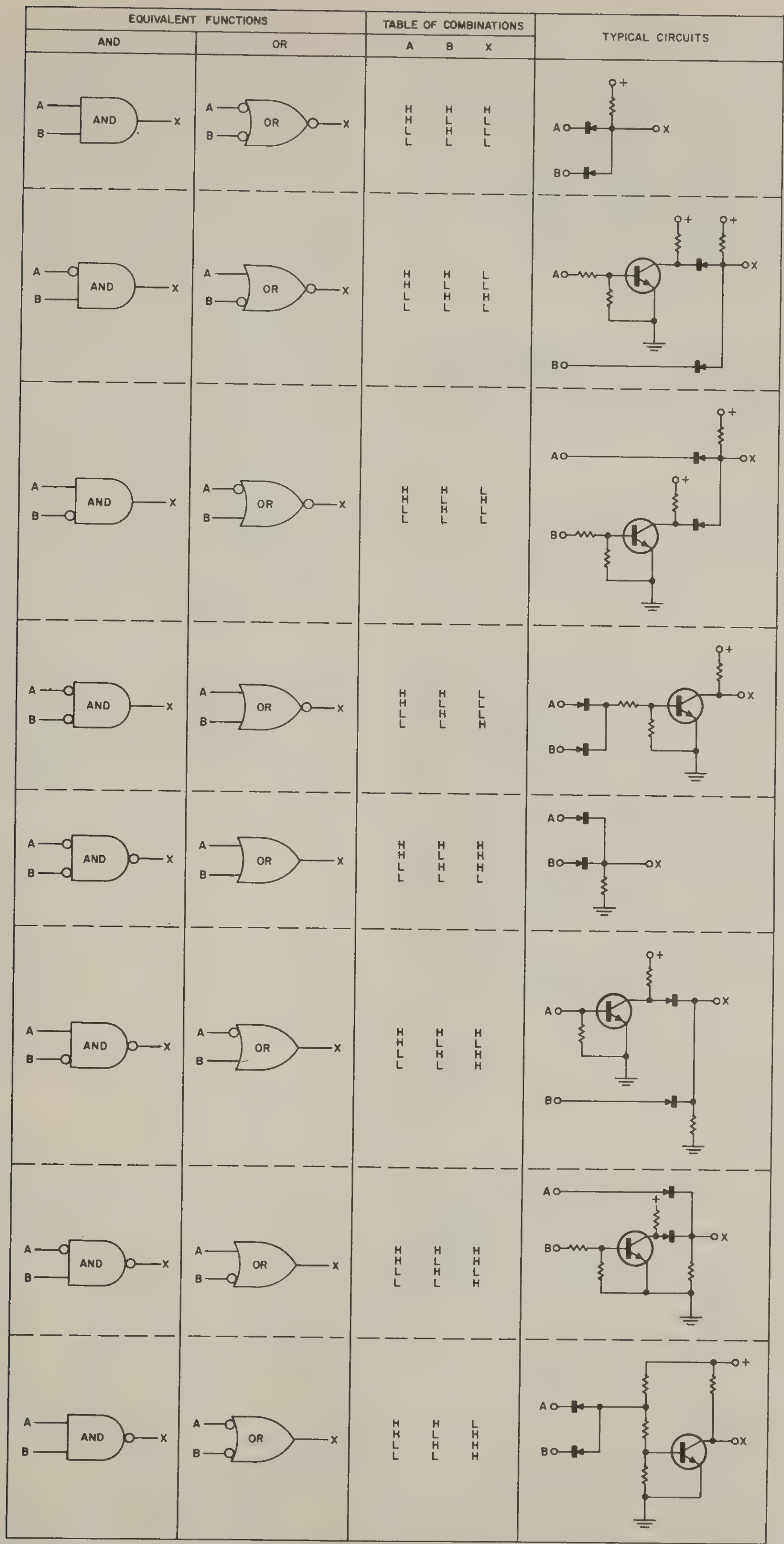
d. Operating Level Adjustments

For level adjustments and jumpering information, refer to the INSTALLATION AND OPERATION and pertinent module sections in this manual.

2. DESCRIPTION

The remote control chassis mounts plug-in modules that perform switching functions for station operation. It also includes a local control panel. Nylon guide rails align the modules to mate with connecting pins on the interconnect printed circuit board at the rear of the "warp-around" chassis. The local control panel provides the following local control facilities for service and maintenance:

- XMIT switch -- for local keying of the transmitter
- "PL" DISABLE switch -- disables receiver "Private-Line" tone-coded squelch operation
- LINE DISABLE switch -- disables the dc control line to prevent remote operation of the transmitter
- LOCAL MIKE connector -- allows the use of a local microphone for transmitter service and maintenance.



DEPD-17780-B

Figure 1.
Chart of Typical AND and OR Logic Presentations and Typical Equivalent Circuit Diagrams

3. BASIC CIRCUITS

Several basic circuits are used extensively in the logic circuitry of the Remote Control Unit. The AND gate, the OR gate, the transistor switch, the Schmitt trigger and the bistable multivibrator are the most common. These circuits are described in the following paragraphs.

a. AND and OR Logic

An AND gate has two or more inputs and a single output. All inputs (A and B and C and etc.) must be in the "active" state before the output will be switched from the "inactive" to the "active" state.

An OR gate also has two or more inputs and a single output. Any input (A or B or C or etc.) which is in the "active" state will switch the output from the "inactive" to the "active" state.

Binary logic circuits have two stages which are designated "active" and "inactive". Each of these states may be either of two distinct voltage levels. These voltage levels are designated "high" and "low". The more positive voltage source is considered to be the "high" level and the less positive voltage source is considered to be the "low" level. The "high" and "low" levels are represented by the letters "H" and "L" in the logic truth table. Logic symbols for AND and OR gates show the "high" and "low" voltage levels as follows: A small circle at the input to a gate indicates that the "low" level activates the function. Conversely, the absence of a small circle indicates that the "high" level activates the function. The same is true of the output. A small circle at the output indicates that the "low" level is present when the function is activated and absence of the circle indicates that the "high" level is present when the function is activated.

For example, the first AND gate shown in Figure 1 requires two "high" inputs before the output will be a "high". In all other input conditions, the AND gate will be "inactive" and the output will be "low". In the first OR gate, input A or input B is in the "active" condition when the voltage level is "low". When either of the inputs is "low", the output will also be "low" (active state).

b. Transistor Switches

A switch is characterized by a high resistance in one state and a low resistance in another. Transistors operate as switches if they are operated under nonconducting (cut off) conditions where the resistance of the emitter to collector junction is very high or full saturation conditions where the resistance of the emitter to collector junction is very low. Figure 2. shows the configuration of typical transistor switches.

The transistor switches used in the Remote Control Unit are connected in either the common emitter or common collector configuration. In the common emitter configuration, an inverted output is obtained. With no input signal, there is no forward bias on the transistor, the transistor is cut off and the collector voltage approaches the supply voltage. When an input signal drives the base positive, the transistor is forward biased and starts to conduct. In full saturation, the collector voltage approaches the emitter voltage which is at ground potential.

A non-inverted output is obtained when the transistor is connected in the common collector configuration. With no input signal, the transistor is cut off and the emitter is at ground potential. When a positive input voltage is applied, the transistor is forward biased and the emitter voltage follows the base voltage until the collector voltage (supply voltage) is approached. A large power gain can be obtained from the common collector circuit, however, the voltage gain is always less than one.

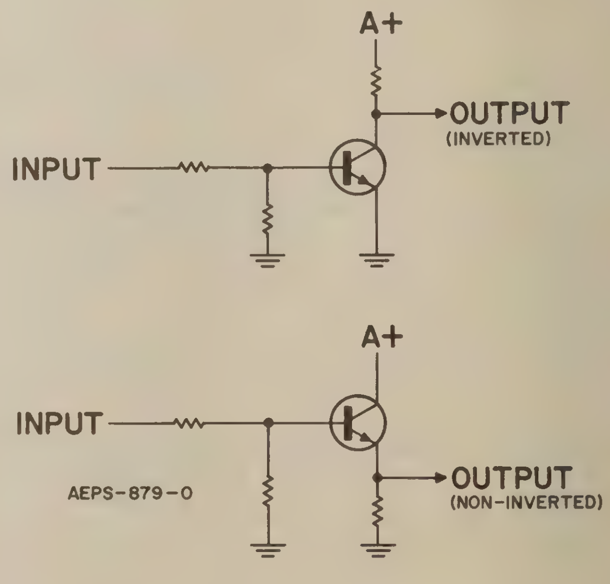


Figure 2.
Typical Transistor Switches

c. Schmitt Trigger

A Schmitt trigger is a regenerative bistable circuit whose state depends on the amplitude of

the input voltage and where feedback is provided by the use of a common emitter resistor. Figure 3. shows the configuration of a typical Schmitt trigger circuit. The output of the Schmitt trigger will be one value if the input exceeds a given level and the output will return to its initial value if the input goes below another level. The circuit is used for detecting a dc level and providing a fast rise square wave output.

In the initial state, Q1 is biased at cut-off and Q2 is biased into conduction. The common emitter voltage is a function of the voltage divider formed by R5 and R7.

When the input drives the base of Q1 positive, Q1 starts to conduct. Its collector voltage drops and this voltage is coupled through R4 to the base of Q2 turning it off. With Q2 in the off state, its collector voltage rises abruptly from its original low level. The common emitter voltage is now a function of the voltage divider formed by R5 and R3.

To return the Schmitt trigger circuit to its original state, the input voltage must drop to a level which no longer forward biases the base of Q1. The output of a Schmitt trigger may be taken at the collector of either Q1 or Q2. The output at the collector of Q1 will be inverted while the output at the collector Q2 will be non-inverted

NOTE:
1. THE REFERENCE NUMBERS SHOWN DO NOT CORRESPOND TO THOSE ON THE SCHEMATIC OR THE PARTS LIST.

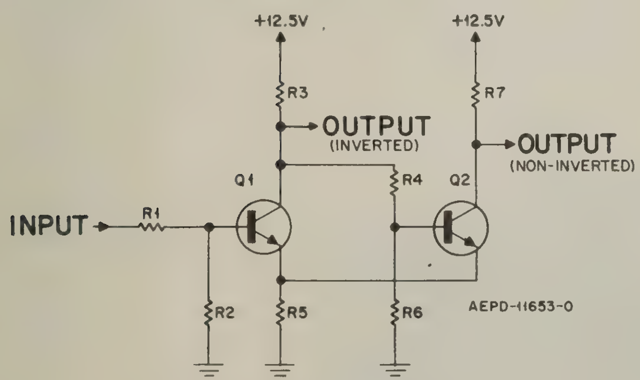


Figure 3.
Typical Schmitt Trigger

d. Bistable Multivibrator

The bistable multivibrator is a double input switching circuit whose state is determined by the input applied and where feedback is used to maintain a given state. Figure 4. shows the configuration of a typical bistable multivibrator circuit.

Due to normal variations in the multivibrator circuit, one transistor will saturate and the other will be cut off upon initial application of dc power. Each transistor is held in its particular state by the condition of the other.

Assume that Q1 begins conducting first when power is applied. The collector voltage of Q1 will attempt to approach the emitter voltage (ground). This voltage is coupled to the base of Q2 through R3, preventing Q2 from conducting. When Q2 is cut off, the collector voltage attempts to rise to the supply voltage. This voltage is coupled through R4 to the base of Q1 driving it further into conduction, which in turn lowers the voltage being coupled to the base of Q2 even more. This sequence continues until one transistor is saturated and the other is cut off.

The inputs are positive voltage signals applied to the bases of the bistable circuit. A positive voltage applied to input #2 forces transistor Q2 to conduct. As Q2 conducts, the collector voltage begins to decrease. This decrease in voltage appears at the base of Q1, cutting it off. When Q1 stops conducting, the collector voltage attempts to rise to the supply voltage. This voltage is then coupled through R3 to the base of Q2, driving it further into conduction.

NOTE:
1. THE REFERENCE NUMBERS SHOWN DO NOT CORRESPOND TO THOSE ON THE SCHEMATIC OR PARTS LIST.

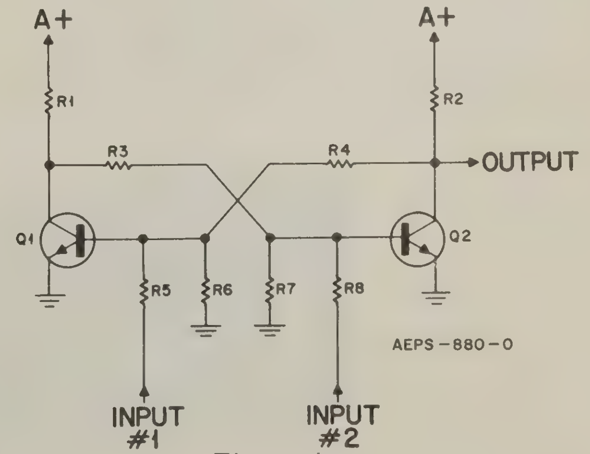


Figure 4.
Typical Bistable Multivibrator

The desired output of the bistable multivibrator circuit may be selected by applying a positive

voltage to the appropriate input. If a positive voltage is applied to input #1, the output will approach the level of the collector supply voltage of Q2. If a positive voltage is applied to input #2, the output will approach zero volts. An output may also be taken from the collector of Q1. This will be inverted from the Q2 collector output.

4. SERVICE AND MAINTENANCE

NOTE

Specialized maintenance procedures for individual modules are described in the respective module sections in this manual.

a. Removal and Replacement of Modules

Modules may be removed by simply pulling outward on the module, and may be replaced by pushing the module into its position in the panel. The modules are labelled and the mounting positions are marked on the DC Interconnect Board at the inside rear of the module housing.

CAUTION

1. Never attempt to plug a module into the pins on the back of the Remote Control Unit.
2. Always be sure of the correct module position before plugging in a module.
3. There are keying plugs in some modules to prevent insertion in the wrong position. Do not remove these plugs from the modules except when using the servicing kit.
4. Remove power to the station before inserting or removing modules to prevent damage to transistors by transients.

Technicians who service many of these stations may wish to carry spares and replace malfunctioning modules for immediate restoration of operation. The module may then be repaired at the shop and used as the next replacement spare.

NOTE

All jumper connections must be identical on modules that are removed and modules that are inserted before swapping can be successfully used as a troubleshooting technique.

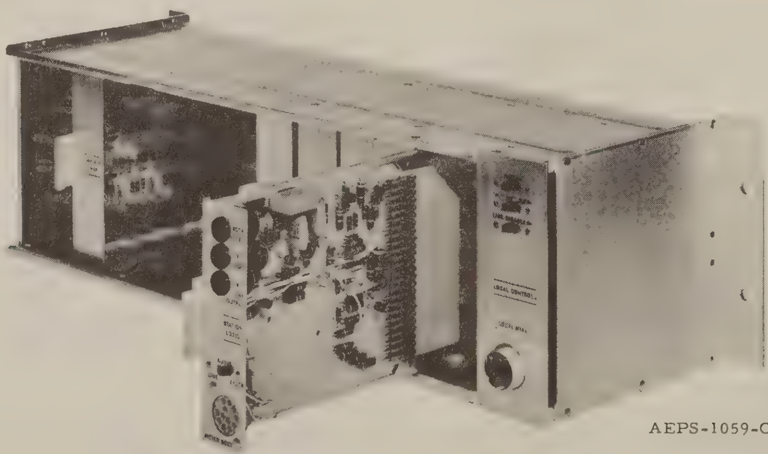
To remove the station local control panel, the station logic module and two mounting screws on the front panel of the local control panel must be removed. Sufficient service loop is provided in the panel intercabling to allow free movement of the panel to pull it out for service. Individual plug-in pins mate with the interconnect board and are identified with a numbered sleeve on the female pin.

b. Installation of Additional Modules

When new functions (optional modules) are added, refer to the pertinent module section in this manual for proper jumpering information.

c. In-Circuit Module Servicing

The Motorola Model TLN8799A Service Board Kit is available for extending the module to provide access for service and maintenance without interrupting the power and signal connections when taking readings.



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Module Extended for Service and Maintenance

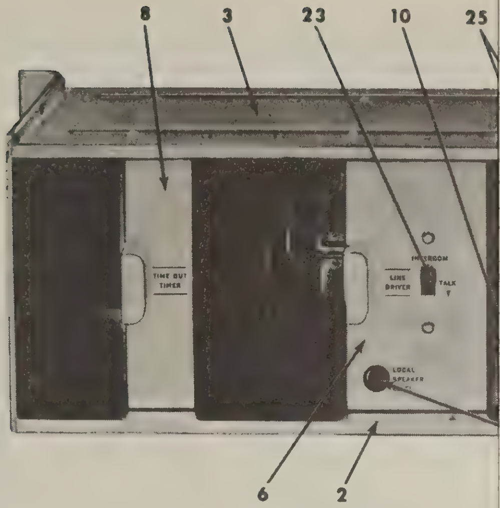
METERING TABLE

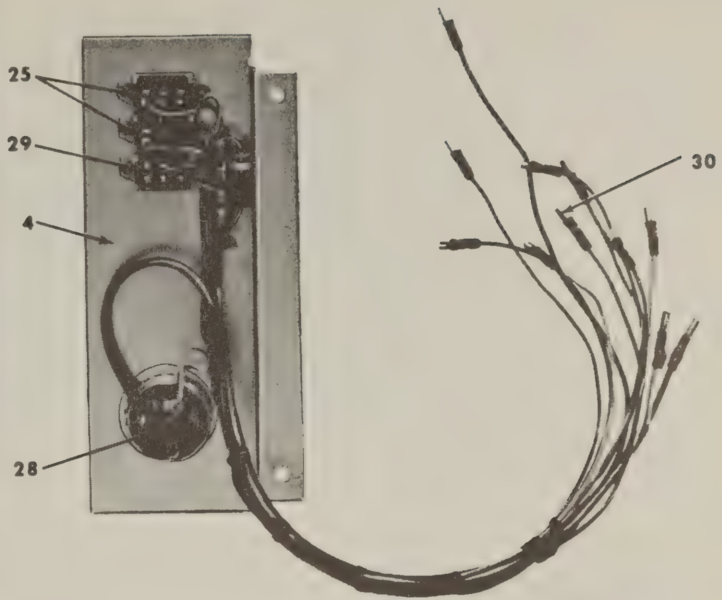
SET UP THE PORTABLE TEST SET AS FOLLOWS:

1. Function switch - XMTR position
2. Oscillator switch - METER REV. position
3. The AUDIO switch on the Station Logic Module must be in the EXCTR position to provide a ground for the test set meter

SELECTOR SWITCH POSITION	CIRCUIT CHECKED	TYPICAL METER READING	
		STANDBY	TRANSMIT
1	LINE P-T-T	*25 uA	0
2	REDUNDANCY	0	40 uA
3	SWITCHED A+	0	40 uA
5	RCVR MUTE	20 uA	**0
6	"PL" DISABLE	20 uA	***0
11	AUDIO	****	

*No reading when keyed locally or in repeater operation.
**Remains 20 uA during repeater operation.
***Meter reading is for "PL" disable condition rather than transmit condition.
****Dependent upon audio levels used at the individual station. Refer to the INSTALLATION AND OPERATION section of the manual for set-up instructions and typical readings.





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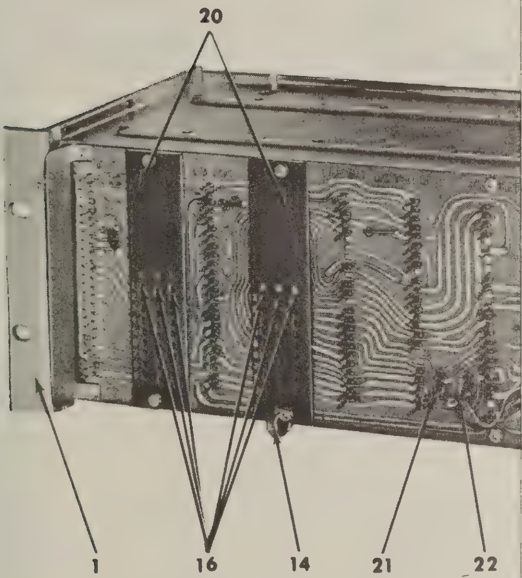
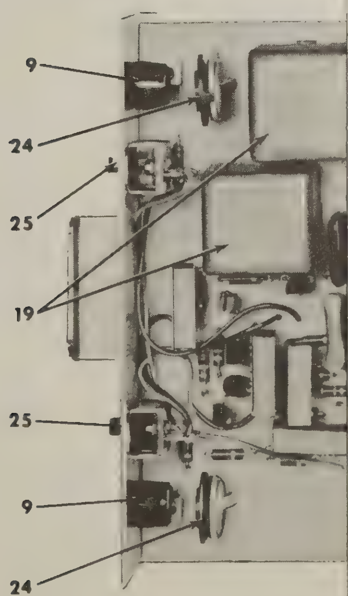
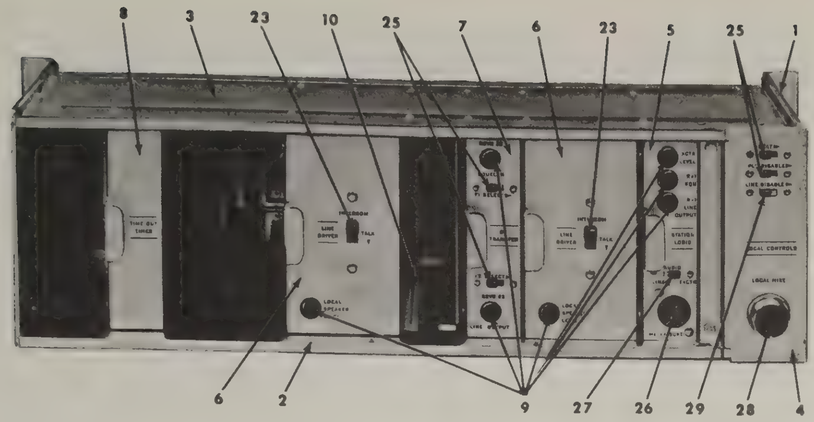




PARTS LIST

PL-1254-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	15C83911G01	Housing (end)
2	15D83912G01	Housing (bottom)
3	15D83913G01	Housing (top)
4	1V80781A16	Local Controls Panel Ass'y
5	1V80781A26	Station Logic Panel Ass'y
6	1V80781A47	Line Driver Panel Ass'y
7	64B83922G01	DC Transfer Panel (1-Freq.)
7	1V80781A28	DC Transfer Panel Ass'y (2-Freq.)
8	64B83927G01	Time-Out Timer Panel
9	43B82721C01	Insulator Bushing
10	45B83914G01	Printed Circuit Board Guide
11	9A83445D01	Pin Terminal
12	29A83013H01	Terminal Receptacle
13	42A80273	Cable Clamp
14	42A82143C02	Cable Clamp 1/4"
15	46B83284H01	Keying Plug
16	9B83965G01	Receptacle, Board Mtg
17	9B83011H01	Receptacle, Board Mtg
18	40B82786A02	Push Switch
19	26K858660	Coil Shield
20	14B83127H01	Insulated Connector
21	1V80781A61	Wire and Terminal Ass'y
22	1V80700B26	Wire and Terminal Ass'y
23	40B83881C01	Switch 3 pdt
24	18C83083G03	Potentiometer, 25K ohms
	18C83083G04	Potentiometer, 1K ohm
25	40B83468E01	Switch, spst
26	9C83478E01	12 contact connector receptacle (female) Metering Receptacle
27	40B83204B01	Switch dpdt
28	9K830418	4 cont connector receptacle (female) Microphone Receptacle
29	40B83204B01	Switch dpst
30	9B83012H01	Wire Crimp Receptacle



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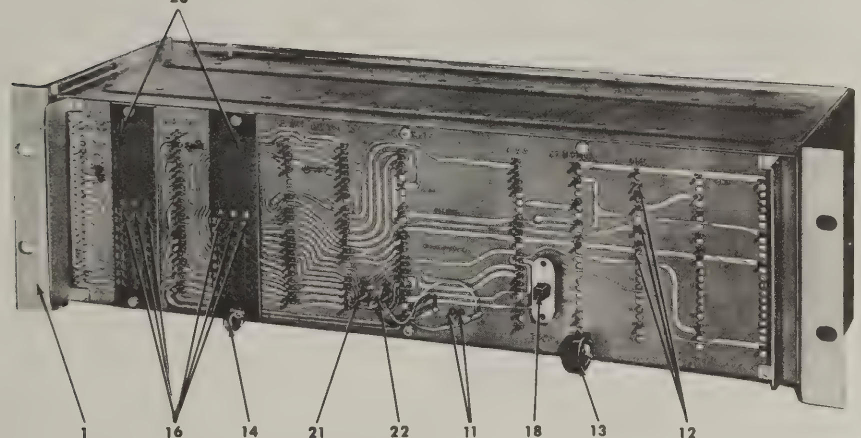

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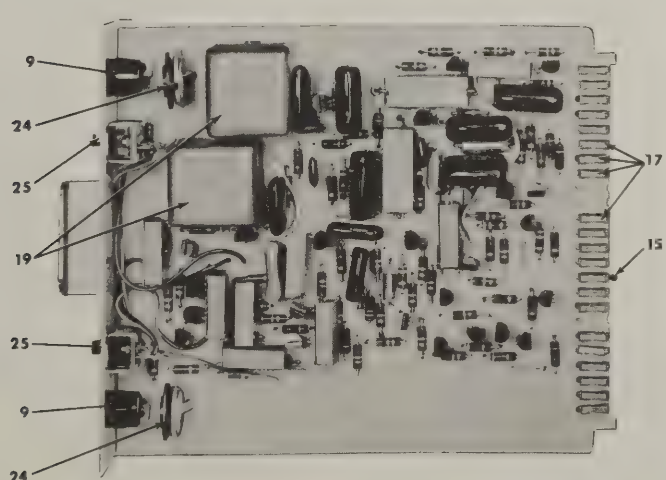

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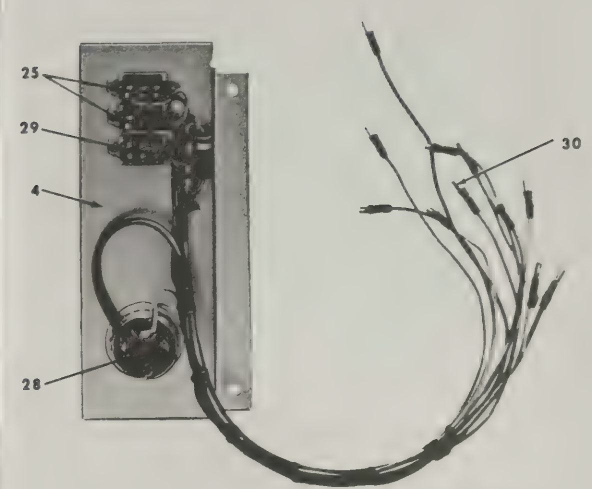
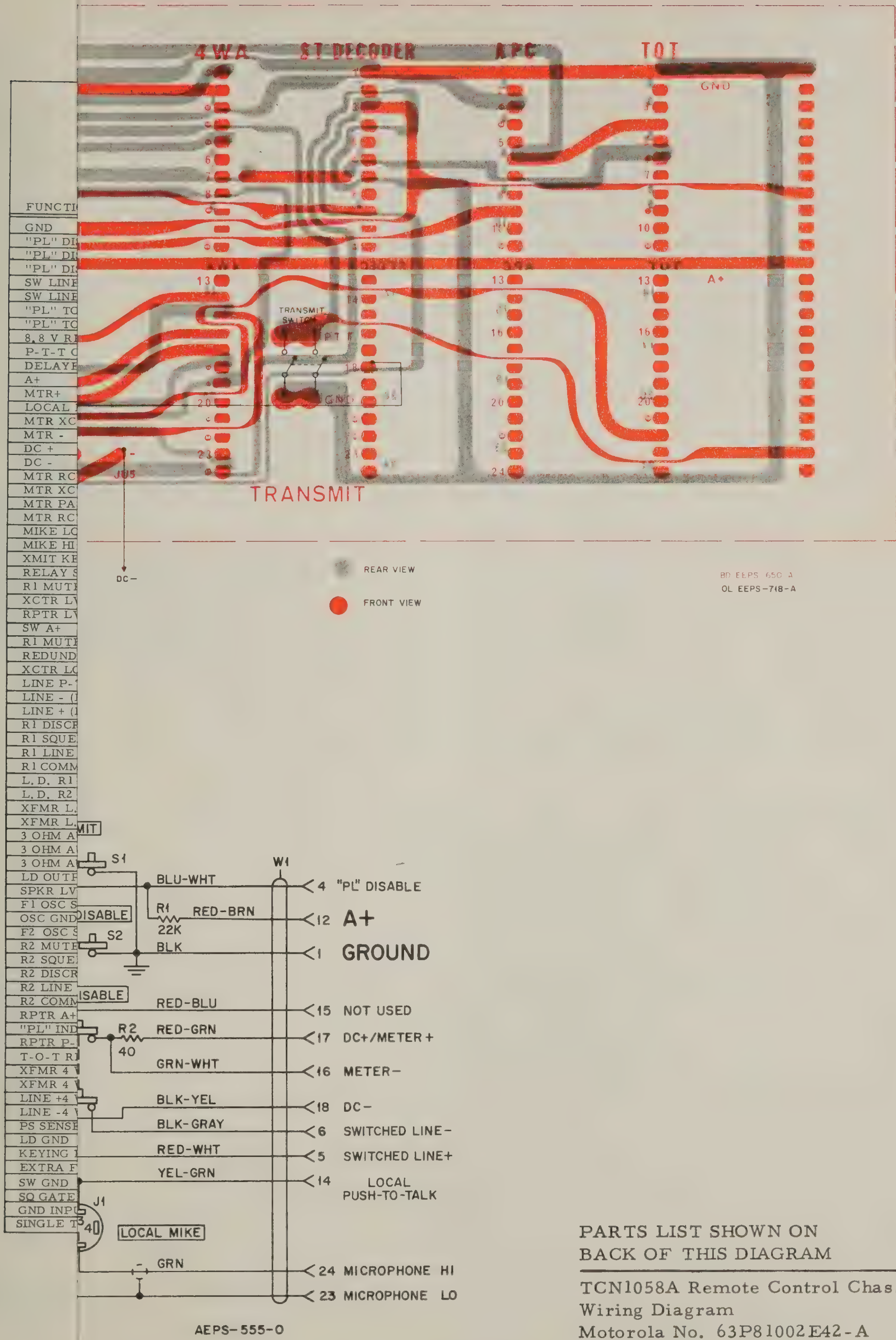


AEPS-1253-O

PARTS LIST

PL-1254-O

CODE	MOTOROLA PART NO.	DESCRIPTION
1	15C83911G01	Housing (end)
2	15D83912G01	Housing (bottom)
3	15D83913G01	Housing (top)
4	1V80781A16	Local Controls Panel Ass'y
5	1V80781A26	Station Logic Panel Ass'y
6	1V80781A47	Line Driver Panel Ass'y
7	64B83922G01	DC Transfer Panel (1-Freq.)
7	1V80781A28	DC Transfer Panel Ass'y (2-Freq.)
8	64B83927G01	Time-Out Timer Panel
9	43B82721C01	Insulator Bushing
10	45B83914G01	Printed Circuit Board Guide
11	9A83445D01	Pin Terminal
12	29A83013H01	Terminal Receptacle
13	42A80273	Cable Clamp
14	42A82143C02	Cable Clamp 1/4'
15	46B83284H01	Keying Plug
16	9B83965G01	Receptacle, Board Mtg
17	9B83011H01	Receptacle, Board Mtg
18	40B82786A02	Push Switch
19	26K858660	Coil Shield
20	14B83127H01	Insulated Connector
21	1V80781A61	Wire and Terminal Ass'y
22	1V80700B26	Wire and Terminal Ass'y
23	40B83881C01	Switch 3 pdt
24	18C83083G03	Potentiometer, 25K ohms
	18C83083G04	Potentiometer, 1K ohm
25	40B83468E01	Switch, spst
26	9C83478E01	12 contact connector receptacle (female) Metering Receptacle
27	40B83204B01	Switch dpdt
28	9K830418	4 cont connector receptacle (female) Microphone Receptacle
29	40B83204B01	Switch dpst
30	9B83012H01	Wire Crimp Receptacle



PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

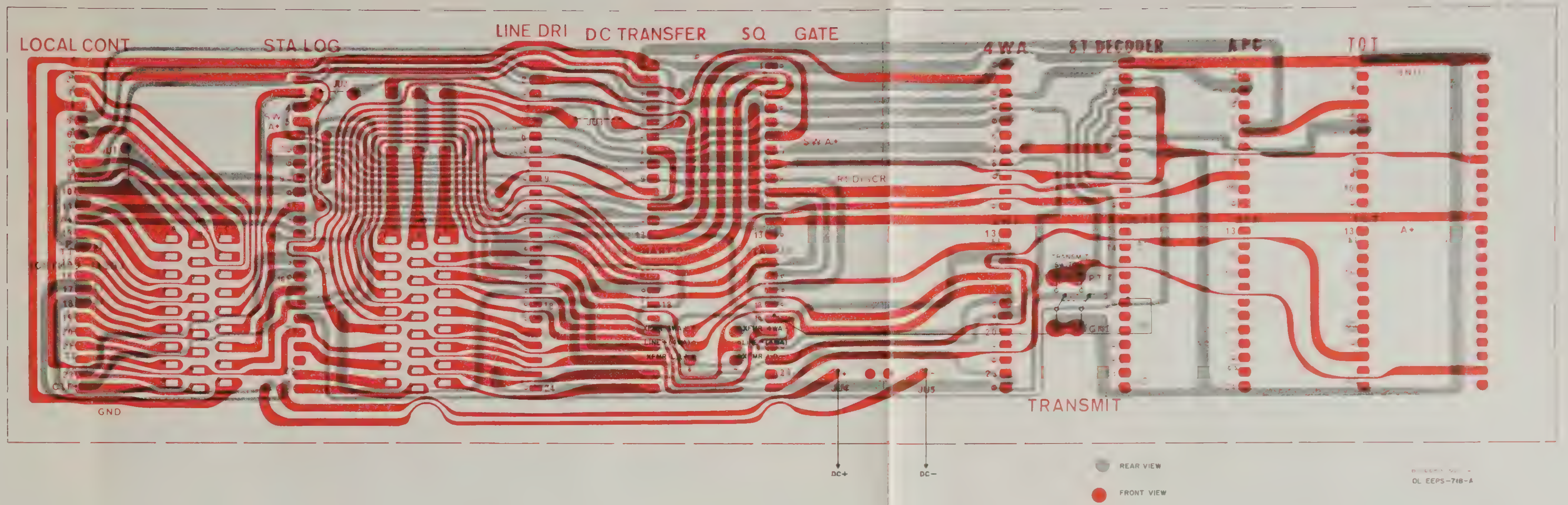
TCN1058A Remote Control Chassis
Wiring Diagram
Motorola No. 63P81002E42-A
3/15/69-GM

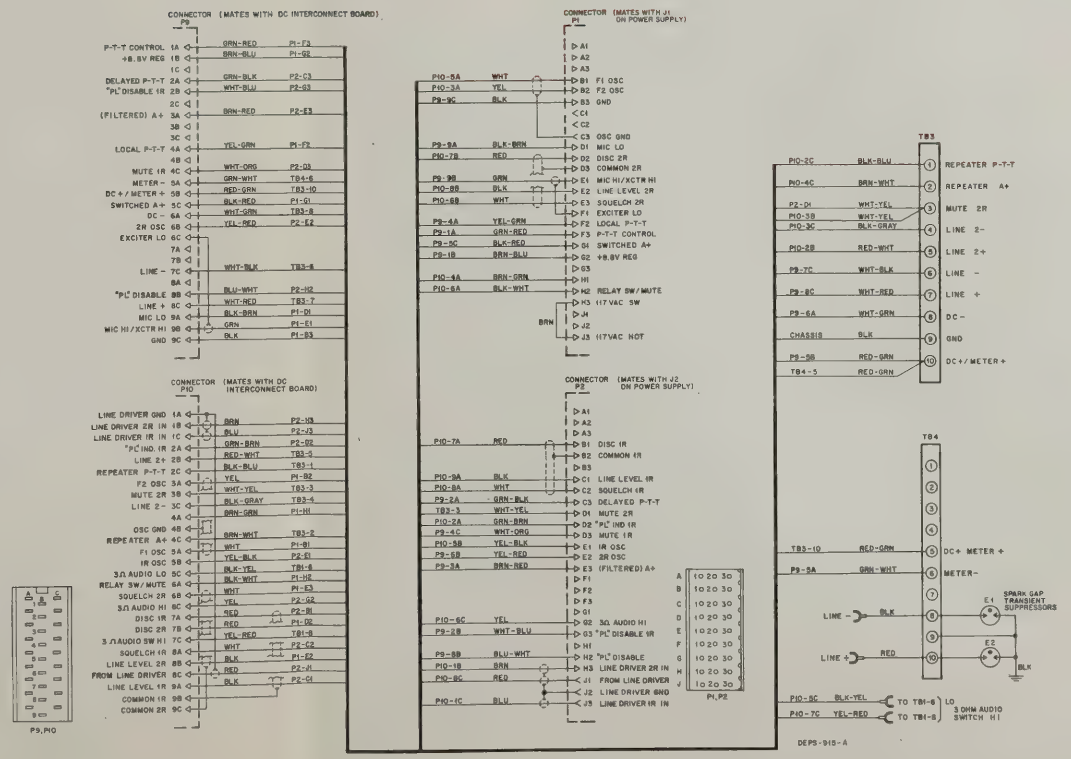
MODULE INTERCONNECTION TABLE

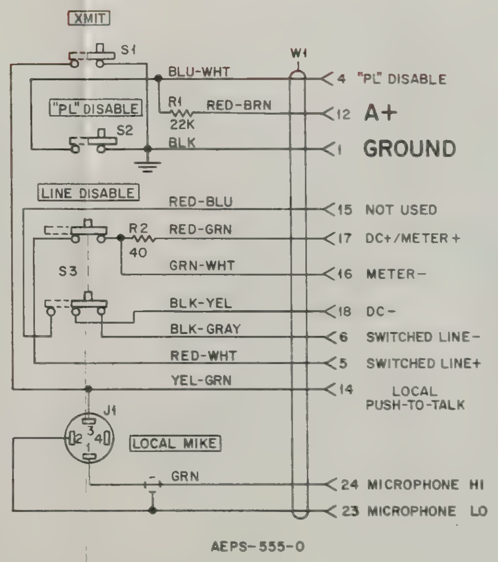
FUNCTION	LOGIC CONTROL PANEL	STATION LOGIC	LINE DRIVER	DC TRANSFER	SQUELCH GATE	4-WIRE AUDIO	SINGLE TONE DECODER	TIME-OUT TIMER	P9	P10	JUMPER
GND	1	1		1	1		1	1	9C		
"PL" DIS R2									3C		
"PL" DIS R1									2B		
"PL" DIS	4	20		2					8B		
SW LINE +	5			3							
SW LINE -	6			4							
PL TONE LO									1C		
PL TONE HI									2C		
8.8 V REG				5					1B		
P-T-T CONT		10		8				6	1A		1
DELAYED P-T-T		13							2A		
A+	12	12	12	12	12	12	12	12	3A		
MTR+									3B		
LOCAL P-T-T	14			6	18				4A		1
MTR XCTR +									4B		
MTR -	16								5A		
DC +	17								5B		4
DC -	18								6A		5
MTR RCVR #2									6B		
MTR XCTR -									7A		
MTR PA GRID									7B		
MTR RCVR #1									8A		
MIKE LO	23	15							9A		
MIKE HI	24	16							9B		
XMIT KEY INHIBIT		8						4			
RELAY SW/MUTE		2	2	17		2				6A	
R1 MUTE		3							4C		
XCTR LVL		4	19			19					2
RPTR LVL		5			13						
SW A+		6		13	6				5C		
R1 MUTE INHIBIT		7			17						
REDUNDANCY		9		7							
XCTR LO		11			24	15			6C		
LINE P-T-T		14		11	16						
LINE - (L.D.)		17	17						7C		
LINE + (L.D.)		18	16						8C		
R1 DISCR		19			10		3			7A	
R1 SQUELCH		21								8A	
R1 LINE LVL		23								9A	
R1 COMMON		24								9B	
L.D. R1 IN			4							1C	3
L.D. R2 IN			5			5				1B	
XFMR L.D. +			14								LD+
XFMR L.D. -			18								LD-
3 OHM AUDIO LO			20							5C	
3 OHM AUDIO HI			21							6C	
3 OHM AUDIO SW			22							7C	
LD OUTPUT			23							8C	
SPKR LVL			24			24					
F1 OSC SW				14	3					5A	
OSC GND				15	2					4B	
F2 OSC SW				16						3A	
R2 MUTE RPTR				20	21					3B	
R2 SQUELCH				21						6B	
R2 DISCR				22						7B	
R2 LINE LVL				23						8B	
R2 COMMON				24						9C	
RPTR A+					20					4C	
PL IND.					14					2A	
RPTR P-T-T					15					2C	
T-O-T RESET					22			22			
XFMR 4 WA +						14					4 WA+
XFMR 4 WA -						18					4 WA-
LINE -4 WA						16				2B	L2+
LINE -4 WA						17				3C	L2-
PS SENSE										4A	
LD GND			1			1				1A	
KEYING PLUG		22	6	9	11	6	4	3			
EXTRA FUNCTION				10						5B	
SW GND							17				
SQ GATE INHIBIT					19		18				
GND INPUT							19				
SINGLE TONE RESET					8		9				

ALL ENTRIES ON A HORIZONTAL LINE ARE COMMON POINTS WHICH ARE INTERCONNECTED BY THE BOARD PLATING.

EPS-914-A





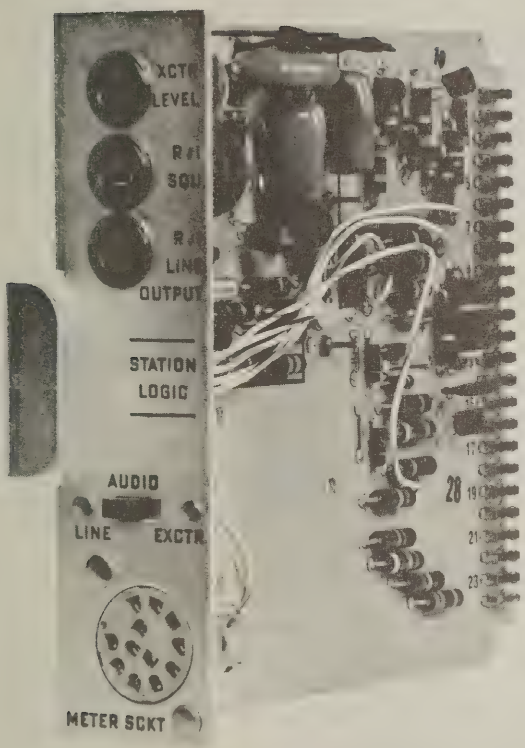


PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TCN1058A Remote Control Chassis Wiring Diagram
Motorola No. 63P81002E42-A
3/15/69-GM

STATION LOGIC MODULE

MODEL TLN1173A



1. DESCRIPTION

The TLN1173A Station Logic Module is a fully transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnect board of the remote control chassis.

2. FUNCTIONS

This module contains the Line Output, Squelch, and Exciter Level controls. It exercises push-to-talk control over other station functions from local or line push-to-talk commands. It also switches the antenna relay, for channel element turn-on and activates the power supply for the transmit mode. On command, a ground is connected for operating the antenna relay and for muting the receiver.

3. CIRCUIT DESCRIPTION

a. Control Functions

A signal from the receiver discriminator, entering the module on pin 19, is routed to the receiver squelch circuit through the R#1 SQUELCH control and pin 21. The signal also passes through the R#1 LINE OUTPUT control to pin 23 for amplification in the receiver audio stages when the receiver is unsquelched.

b. Audio Functions

An audio signal entering the module on pin 4 passes through capacitor C1 into the XCTR LEVEL control and into Paraphase Amplifier Q1. For the line levels below 0 dbm, JU2 is installed. If the level is above 0 dbm, JU2 is not used. From the collector of Q1, the amplified signal is sent to Exciter Audio Amplifier Q2 for further amplification and out the transmitter exciter audio input.

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PARTS LIST

TLN8760A Local Station Control Panel PL-268-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CONNECTOR, receptacle:
J1	9K830418	female; 4 contact; does not include; 4S7699 LOCKWASHER 13/16"; 2A482070 NUT, ring
		RESISTOR, fixed:
R1	6S128685	22K ±10%; 1/4 w
R2	17C82036G31	40 ±2%; 2 w
		SWITCH, slide:
S1, 2	40B83468E01	spst
S3	40B83204B01	dpst
		CABLE ASSEMBLY:
W1	1V80700B34	includes ref. parts R1, R2, misc. leads and the following: 9B83012H01 RECEPTACLE, wire crimp; 11 req'd.
		SLEEVING, coded
		37C82603D01 No. 1
		37C82603D04 No. 4
		37C82603D05 No. 5
		37C82603D06 No. 6
		37C82603D12 No. 12
		37C82603D14 No. 14
		37C82603D16 No. 16
		37C82603D17 No. 17
		37C82603D18 No. 18
		37C82603D23 No. 23
		37C82603D24 No. 24
	NON-REFERENCED ITEM	
	64B83916G01	BRACKET, panel

TLN8777A DC Interconnecting Board PL-269-O

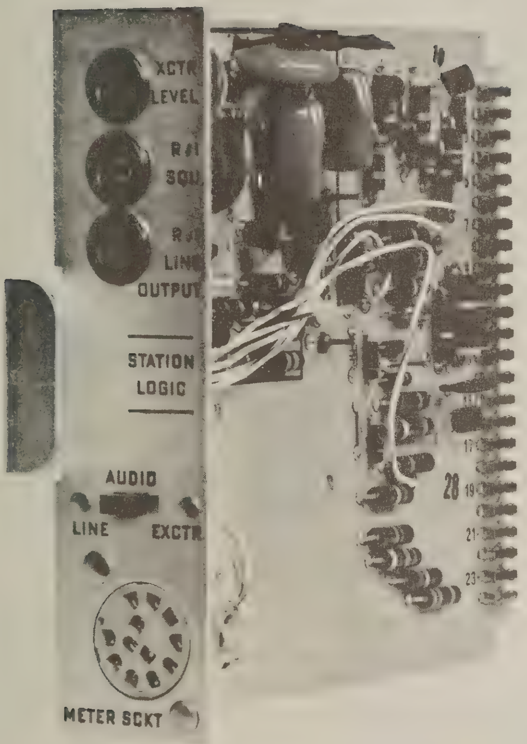
	1V80781A60	PRINTED CIRCUIT BOARD ASSY.
	40B82786A02	SWITCH, push
	1V80781A61	WIRE & TERMINAL ASSY, includes; 29B83446D01 PIN, terminal: female 30S10286B25 WIRE, #24 str.; RED-GRN; 4" length
	1V80700B26	WIRE & TERMINAL ASSY., includes; 29B83446D01 PIN, terminal: female 30S10286B48 WIRE, #24 str., WHT-GRN; 5" length
	10S518	WIRE, solid: #22 tinned copper 1" length

TKN6354A Cable Kit PL-270-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		SPARK-GAP:
E1, 2	80B83029H01	230 v dc; shunt capacity 2 pF
		CONNECTOR, plug:
P1, 2		includes; 14C82337A11 INSULATOR, plug: 27 ckt.; 29C82336A01 TERMINAL, wire; female; for #14-#20 wire 29C82336A02 TERMINAL, wire; female; for #22-#28 wire 29C82335A01 TERMINAL, wire; male; for #14-#20 wire 29C82335A02 TERMINAL, wire; male; for #22-#28 wire 15C83934A11 COVER, plug
P9, 10		includes; 14C83033H01 INSULATOR, plug: 29C83013H02 TERMINAL, wire: for #20-#24 wire: 5A483208 GROMMET 15B83096H01 COVER, plug
		BOARD, terminal:
TB3, 4	31B848187	10 terminals
	NON-REFERENCED ITEMS	
	29K847854	LUG, slotted tongue; 4 used
	30K865737	WIRE, shielded: RED
	30K863486	WIRE, shielded: GRN
	30K865593	WIRE, shielded: BLU
	30C83348B01	WIRE, shielded: BRN
	30C83236B01	CABLE, 3-conductor; shielded
	30B848407	CABLE, 2-conductor; shielded WHT

STATION LOGIC MODULE

MODEL TLN1173A



1. DESCRIPTION

The TLN1173A Station Logic Module is a fully transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnect board of the remote control chassis.

2. FUNCTIONS

This module contains the Line Output, Squelch, and Exciter Level controls. It exercises push-to-talk control over other station functions from local or line push-to-talk commands. It also switches the antenna relay, for channel element turn-on and activates the power supply for the transmit mode. On command, a ground is connected for operating the antenna relay and for muting the receiver.

3. CIRCUIT DESCRIPTION

a. <u>Control Functions</u>

A signal from the receiver discriminator, entering the module on pin 19, is routed to the receiver squelch circuit through the R#1 SQUELCH control and pin 21. The signal also passes through the R#1 LINE OUTPUT control to pin 23 for amplification in the receiver audio stages when the receiver is unsquelched.

b. <u>Audio Functions</u>

An audio signal entering the module on pin 4 passes through capacitor C1 into the XCTR LEVEL control and into Paraphase Amplifier Q1. For the line levels below 0 dbm, JU2 is installed. If the level is above 0 dbm, JU2 is not used. From the collector of Q1, the amplified signal is sent to Exciter Audio Amplifier Q2 for further amplification and out the transmitter exciter audio input.

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The Repeater Level control (external to the module) is connected to the circuit through pin 5 at diode CR1. When a high-resistance path appears at pin 5, CR1 is reverse-biased, and the audio path from pin 4 is through amplifier Q1 as previously described. When the path at pin 5 becomes a low resistance, diode CR1 becomes forward-biased and gates the signal around Paraphase Amplifier Q1. The signal then feeds into Exciter Audio Amplifier Q2 as before.

The Local Mic Audio Switch is normally conducting to provide a ground for local microphone audio. Whenever line push-to-talk occurs, Q3 is cut off, removing the local microphone audio ground path. This cutoff gives line audio priority over local microphone audio signals.

c. Circuit Control Functions

When a local or line push-to-talk input is applied to pin 10 or 14, it is applied to the base of P-T-T Inverter, Q4. The "low" input is changed to a "high" level in the inverter, then applied to the Antenna Relay and Mute Switch.

In "Private-Line" applications, push-to-talk release is delayed at the end of a transmission by an input to pin 13 from the external "Private-Line" reverse-burst circuitry. This input holds the P-T-T circuit operated for the duration of the reverse-burst tone.

When a "high" from the P-T-T Inverter is received at the Antenna Relay and Mute Switch, a "low" at its output mutes receiver No. 1 and operates the antenna relay switch, audio disable, and line driver disable circuits.

In repeater applications, a ground appears at pin 7, which prevents Mute Switch Q6 from operating. This allows the receiver in the repeater to remain operational for retransmission of the received signal.

The P-T-T Inverter controls the switched A+. Switched A+ is applied after a 35-millisecond delay to allow the antenna relay to switch to the transmit position before the rf power is applied. A+ from the external redundancy circuit must also be present through pin 9 for switch A+ to be present. When the redundancy input is present, and the switched A+ is turned on by the P-T-T Inverter, the external transmitter circuits are energized to produce an rf output.

In repeater applications without wire-line control, jumper JU1 is used and switched A+ is provided without the redundancy input previously described.

When the time-out timer reaches the end of its cycle, the Transmitter Key Inhibit (through pin 8 on the module) removes the switched A+.

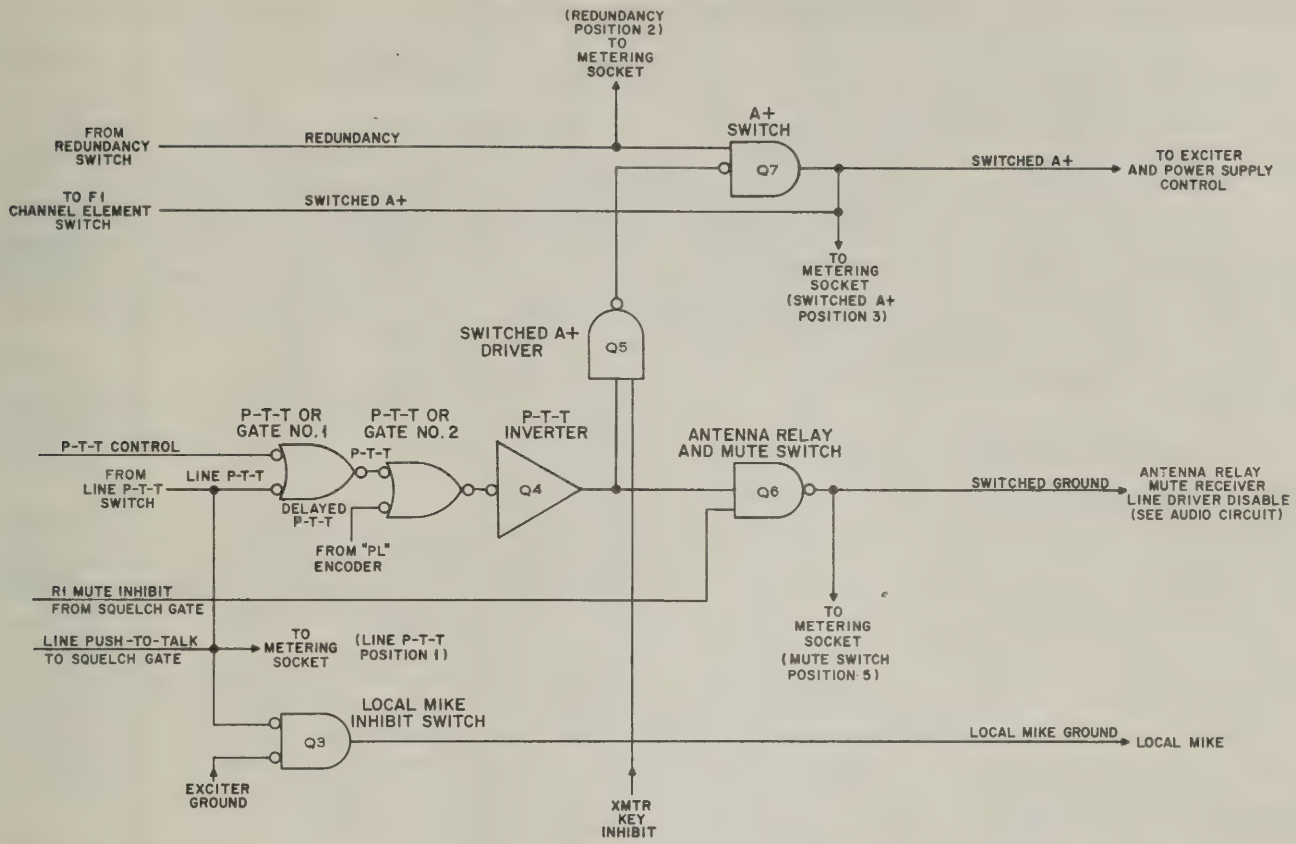
d. Metering Facilities

A receptacle is provided on the module front panel for metering of the functions available at the module. The functions metered and their corresponding Motorola Test Set positions are given in the following table:

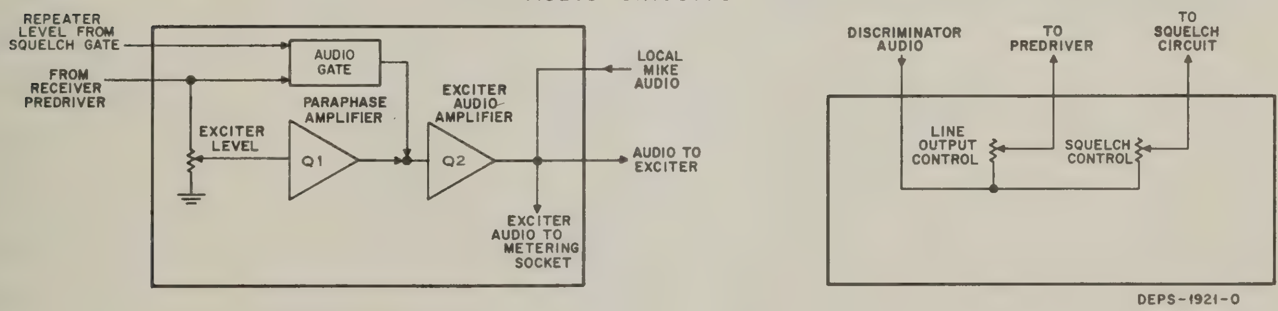
Function	Test Set Meter Position	Typical Reading (UA)	
		Standby	Transmit
Exciter Audio Level	11*	As required	
Line Audio Level	11**	As required	
Line Push-To-Talk Logic	1	25 min	0
Switched A+ Logic	3	0	25 min
Redundancy Logic	2	0	25 min
Receiver Mute Switching Logic	5	12	0
"Private-Line" Disable Logic	6	12***	12***

*With Module switch in EXCTR position.
**With module switch in LINE position.
***2 uA in community repeaters.

CONTROL CIRCUITS



AUDIO CIRCUITS



Functional Block Diagram

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access remove the module, insert the Model TKN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 11, 24	Ground
4	Audio oscillator through 0.1 uF
12 ~~1, 2,~~ 9	+12 volts dc
16	AC Voltmeter to ground
2	10K ohms to 12 volts dc
4	10K ohms to 12 volts dc
6	10K ohms to ground
15	10K " TO 12VDC

b. Module Malfunction Location Techniques

(1) Connect voltage and signal sources to the module as indicated in the preceding table.

(2) Adjust the audio oscillator output for -25 dbm at pin 4. With this input, the level at pin 16 should measure approximately -10 dbm with JU2 connected. If this level cannot be achieved, check stages Q1 and Q2. If the level is correct, ground pin 5. The reading at pin 16 should fall to zero. If this does not occur, check diode CR1 and resistor R41.

(3) Ground pin 14. With a dc voltmeter, measure the voltage at pins 6 and 15. Each should read +12 volts. The voltage measured at pin 2 should read zero.

Refer to the schematic diagram. If a voltage or ground does not appear at the prescribed location, check each stage, in turn, that feeds into the pin indicating the malfunction.

(4) With pin 14 grounded, ground pin 8. With a dc voltmeter, look for +12 volts dc at pin 2 and ground at pin 6. If these are present the Antenna Relay and Mute Switch, A+ Switch Driver, and A+ Switch are functioning properly.

(5) With pin 14 grounded, unground pin 8. and ground pin 7. Pin 2 should read +12 volts dc and pin 6 should read +12 volts dc.

GROUND

ANT. RELAY SW.
AUDIO DISABLE
LINE DRIVER DISABLE

R1 MUTE

EXCITER LEVEL

REPEATER LEVEL

SWITCHED A+

R1 MUTE INHIBIT

XMTR KEY INHIBIT

REDUNDANCY

P-T-T CONTROL

EXCITER GROUND

A+

DELAYED P-T-T

LINE P-T-T

LOCAL MIC. AUDIO GND

EXCITER INPUT

LINE (—)

LINE (+)

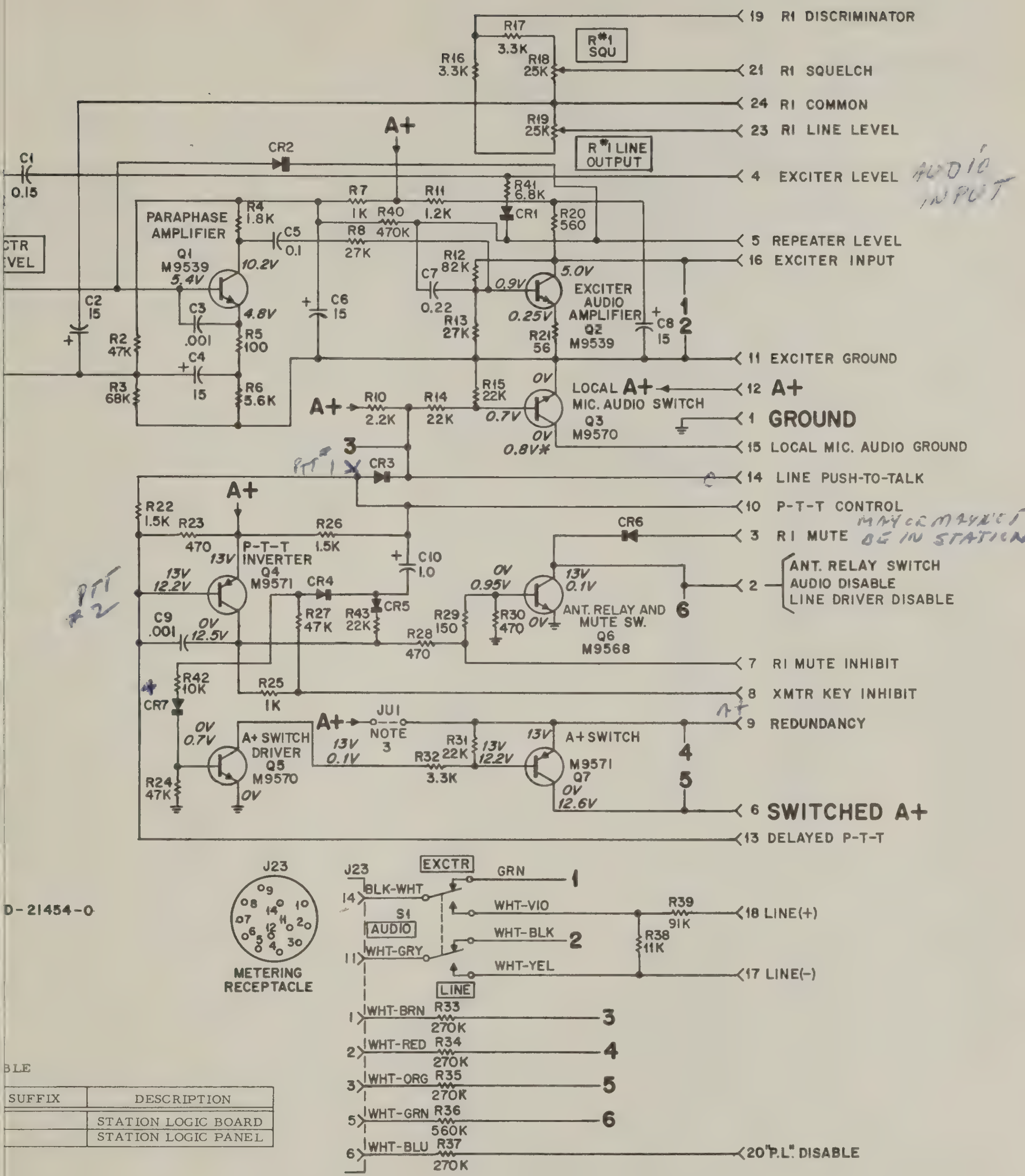
R1 DISC.

"PL" DISABLE

R1 SQUELCH

R1 LINE LEVEL

R1 COMMON



BLE

SUFFIX	DESCRIPTION
	STATION LOGIC BOARD
	STATION LOGIC PANEL

00).
RADS.
-T-T IS GROUNDED WHERE TWO

	JU1
	OUT
	IN
	IN
	OUT
	IN
	IN

NSMIT AUDIO LEVEL FROM THE
GREATER AS MEASURED AT THE
THIS LEVEL IS BELOW 0 DBM.

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TLN1173A Station Logic Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E44-O
5/17/69-AP

EPS-1028-O

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access remove the module, insert the Model TKN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 11, 24	Ground
4	Audio oscillator through 0.1 uF
12 ~~1, 2,~~ 9	+12 volts dc
16	AC Voltmeter to ground
2	10K ohms to 12 volts dc
4	10K ohms to 12 volts dc
6	10K ohms to ground
15	10K " TO 12VDC

b. Module Malfunction Location Techniques

(1) Connect voltage and signal sources to the module as indicated in the preceding table.

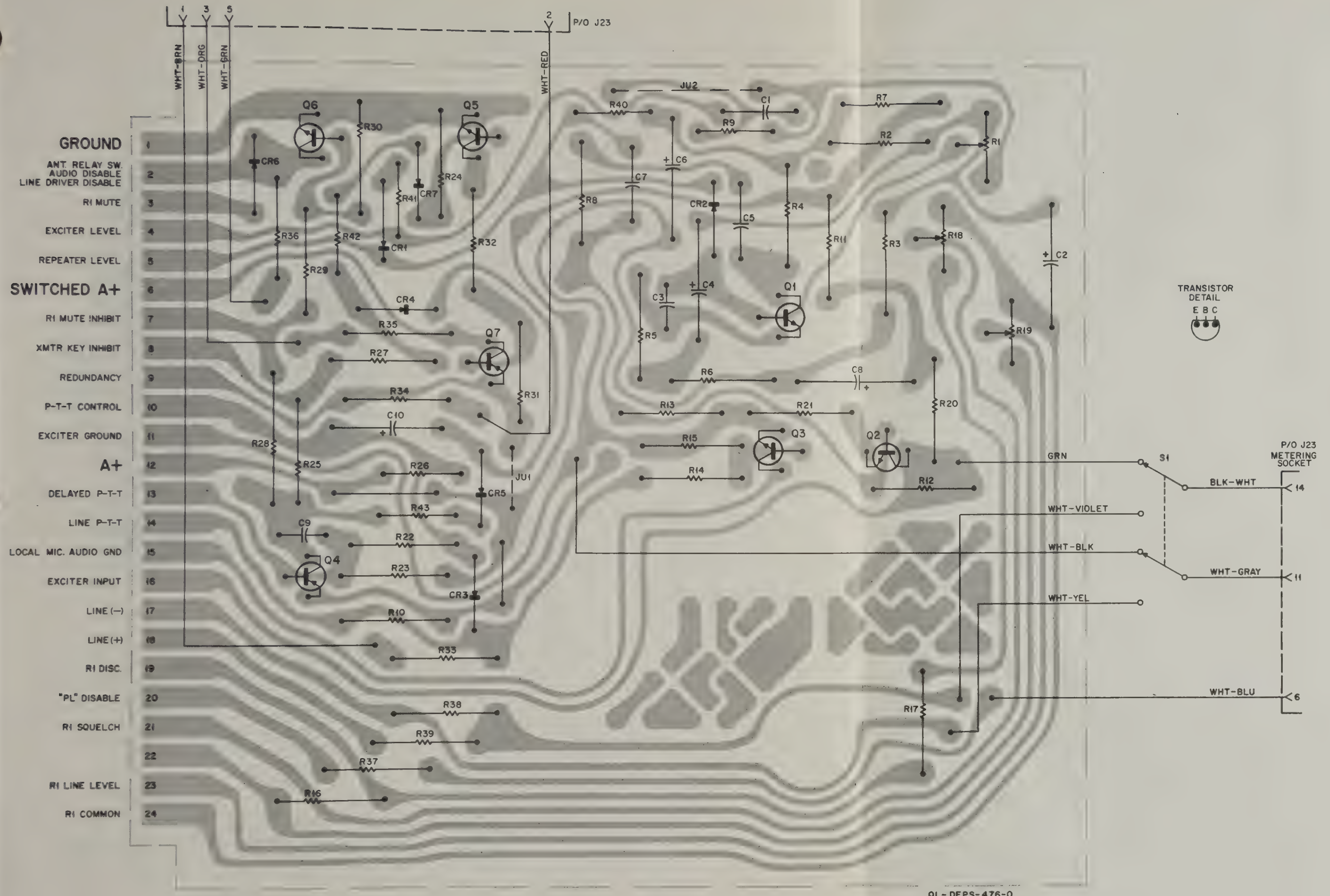
(2) Adjust the audio oscillator output for -25 dbm at pin 4. With this input, the level at pin 16 should measure approximately -10 dbm with JU2 connected. If this level cannot be achieved, check stages Q1 and Q2. If the level is correct, ground pin 5. The reading at pin 16 should fall to zero. If this does not occur, check diode CR1 and resistor R41.

(3) Ground pin 14. With a dc voltmeter, measure the voltage at pins 6 and 15. Each should read +12 volts. The voltage measured at pin 2 should read zero.

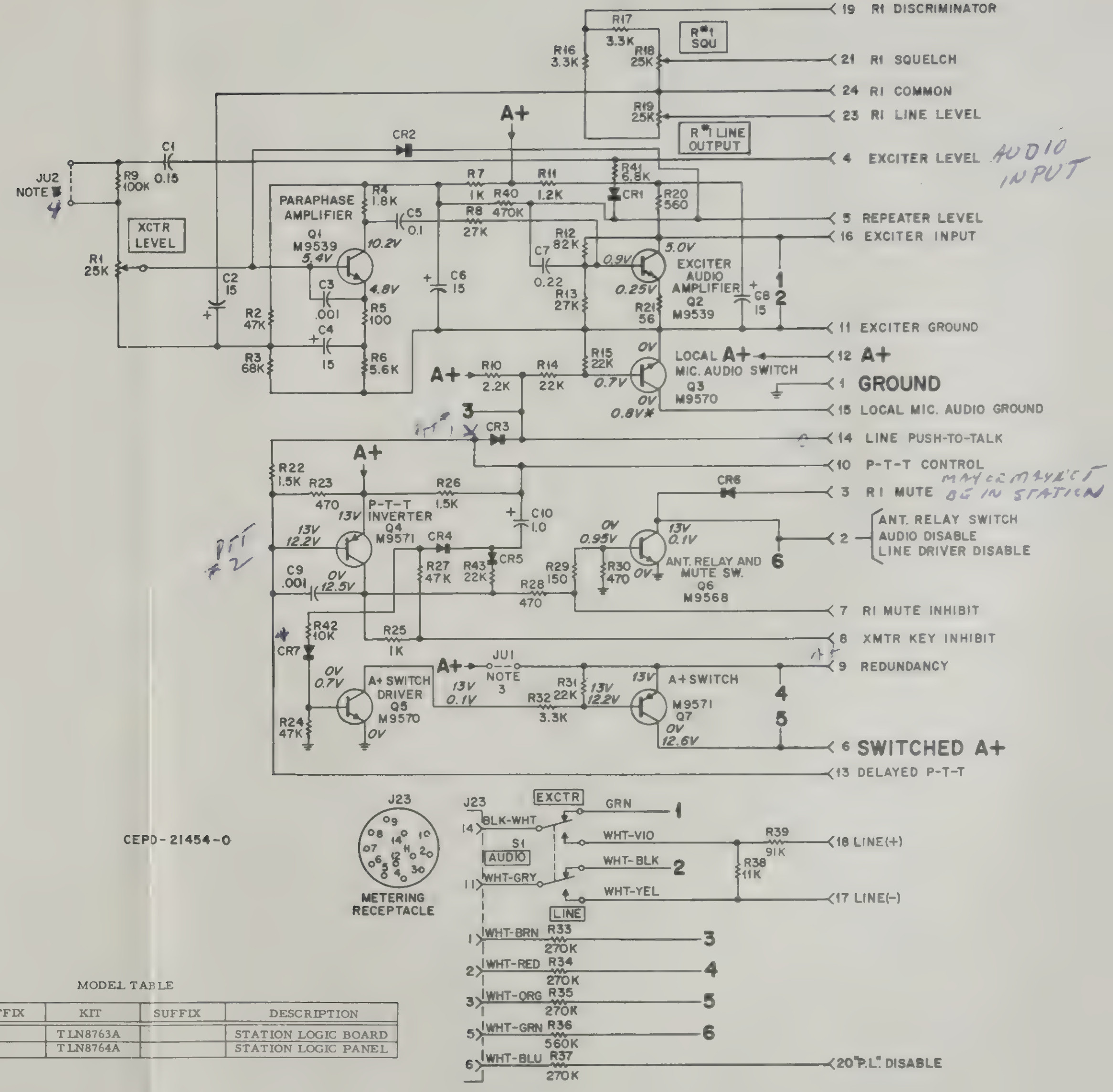
Refer to the schematic diagram. If a voltage or ground does not appear at the prescribed location, check each stage, in turn, that feeds into the pin indicating the malfunction.

(4) With pin 14 grounded, ground pin 8. With a dc voltmeter, look for +12 volts dc at pin 2 and ground at pin 6. If these are present the Antenna Relay and Mute Switch, A+ Switch Driver, and A+ Switch are functioning properly.

(5) With pin 14 grounded, unground pin 8. and ground pin 7. Pin 2 should read +12 volts dc and pin 6 should read +12 volts dc.



OL-DEPS-476-0
BD-DEPS-477-0



MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1173A		TLN8763A		STATION LOGIC BOARD
		TLN8764A		STATION LOGIC PANEL

NOTES:

1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K=1000).
   CAPACITOR VALUES ARE IN MICROFARADS.
2. * INDICATES VOLTAGES WHEN LINE P-T-T IS GROUNDED WHERE TWO VOLTAGES ARE GIVEN AT ONE POINT
   UPPER VOLTAGE = RECEIVE
   LOWER VOLTAGE = TRANSMIT
3. JUMPER TABLE

APPLICATION	JU1
BASE STATION	OUT
BASE (RA) STATION	IN
REPEATER (RT) STATION WITHOUT WIRE LINE CONTROL	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL	OUT
REPEATER (RA) STATION	IN
COMMUNITY REPEATER (RT)	IN

4. REMOVE JUMPER JU2 WHEN THE TRANSMIT AUDIO LEVEL FROM THE REMOTE CONTROL POINT IS 0 DBM OR GREATER AS MEASURED AT THE STATION. CONNECT THE JUMPER IF THIS LEVEL IS BELOW 0 DBM.

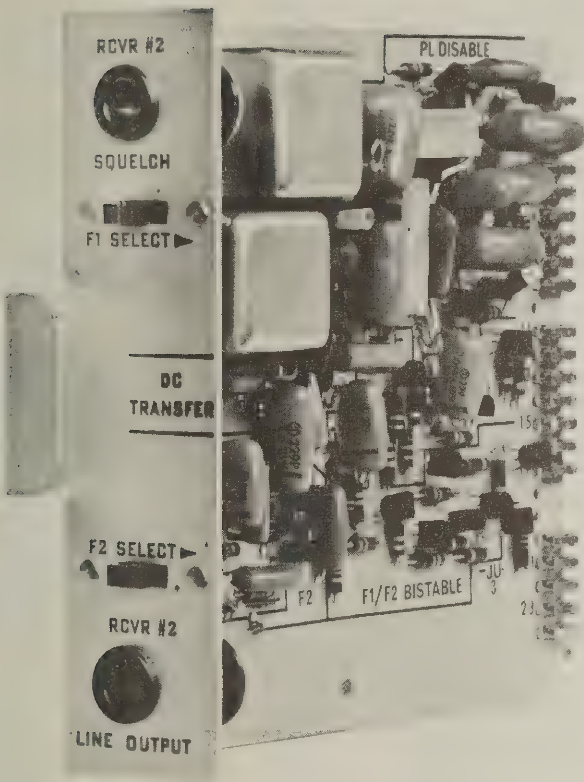
EPS-1028-O

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TLN1173A Station Logic Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E44-O
5/17/69-AP

DC TRANSFER MODULE

MODEL TLN1176A



1. DESCRIPTION

The TLN1176A DC Transfer Module is a fully transistorized, plug-in circuit module for the dc remote control chassis in Motorola two-frequency base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This dc transfer module converts the dc line currents from the remote control point to several functions for operation of the base station.

DC CURRENT	OPERATION
zero	Standby and receive operation.
+5.5 mA	Transmit on frequency #1 (F1).
+12.5 mA	Transmit on frequency #2 (F2).
-2.5 mA	"Private-Line" disable.
-5.5 mA	Mute receiver #2

The line output level and squelch adjustments for receiver #2 are also located on this module. For maintenance and testing, frequency #1 or frequency #2 can be manually selected by the switches on the front panel of the module.

3. FUNCTIONAL OPERATION

a. General

The functions are performed by converting the positive or negative line currents to a 1 MHz oscillation whose amplitude is directly proportional to the magnitude of the applied dc current. The amplitude of the 1 MHz signal determines which functions are performed by overcoming fixed bias levels on the function detectors. The function detectors operate trigger or switching circuits which provide logic "high" or "low" outputs to other units of the station, which perform the desired function.

b. Transfer Oscillators

The positive and negative transfer oscillators are the terminations for the dc control currents from the control line. Each separate oscillator (positive or negative) is activated and powered by a like polarity line current; i.e., positive line current is routed by diodes to the positive transfer oscillator, and negative line currents are routed

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8763A Station Logic Circuit Board PL-285-O

		CAPACITOR, fixed:
C1	8D82905G05	0.15 uF ±10% 50 v
C2, 4, 6, 8	23K865136	15 uF ±20%; 25 v
C3, 9	21D82187B20	.001 uF ±10%; 100 v
C5	8D82905G07	0.1 uF ±10%; 50 v
C7	8D82905G11	0.22 uF ±10%; 50 v
C10	23D82783B08	1.0 uF ±20%; 35 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1 thru 7	48C82392B03	silicon; RD1343
		TRANSISTOR: (SEE NOTE)
Q1, 2	48R869539	N-P-N; M9539
Q3, 5	48R869570	N-P-N; M9570
Q4, 7	48R869571	P-N-P; M9571
Q6	48R869568	N-P-N; M9568
		RESISTOR, fixed; ±10%; 1/2 w; unl stated
R1, 18, 19	18C83083G03	variable; 25K
R2, 27	6S6048	47K
R3	6S6074	68K
R4	6S2089	1.8K
R5	6S6326	100
R6	6S6117	5.6K
R7, 25	6S6229	1K
R8, 13	6S6434	27K
R9	6S129226	100K; 1/4 w
R10	6S6069	2.2K; 1/4 w
R11	6S6393	1.2K
R12	6S5644	82K
R14, 15, 31	6S6397	22K
R16, 17, 32	6S5581	3.3K
R20	6S6291	560
R21	6S5614	56
R22	6S6038	1.5K
R23, 30	6S6090	470
R24	6S5591	18K
R26	6S127803	1.5K; 1/4 w
R29	6S6373	150
R28	6S5772	470; 1 w
R33, 34, 35, 37	6S2050	270K ±5%
R36	6S5796	560K ±5%
R38	6S115017	11K ±5%
R39	6S5789	91K ±5%
R40	6S129148	470K; 1/4 w
R41	6S128687	6.8K; 1/4 w
R42	6S129225	10K; 1/4 w
R43	6S128685	22K; 1/4 w

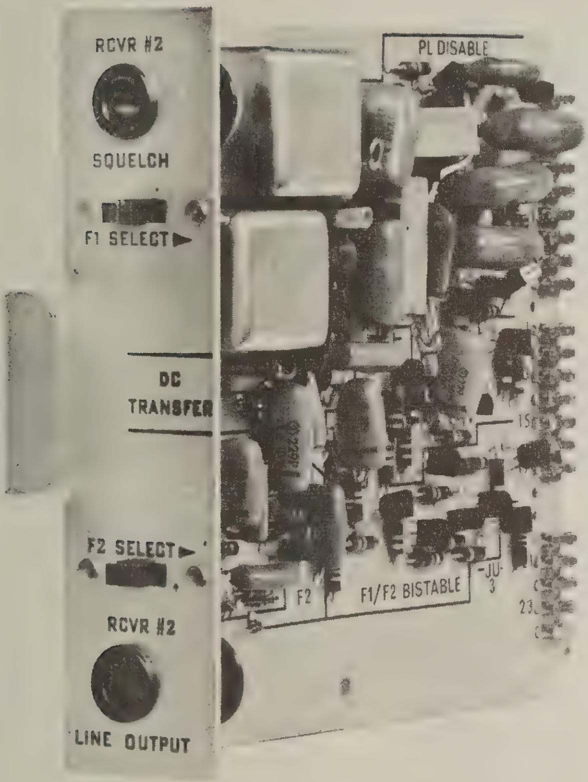
TLN8764A Station Logic Panel PL-286-O

		CONNECTOR, receptacle:
J23	9C83478E01	female; 12 contact
		SWITCH, slide:
S1	40B83204B01	dpdt

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

DC TRANSFER MODULE

MODEL TLN1176A



1. DESCRIPTION

The TLN1176A DC Transfer Module is a fully transistorized, plug-in circuit module for the dc remote control chassis in Motorola two-frequency base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This dc transfer module converts the dc line currents from the remote control point to several functions for operation of the base station.

DC CURRENT	OPERATION
zero	Standby and receive operation.
+5.5 mA	Transmit on frequency #1 (F1).
+12.5 mA	Transmit on frequency #2 (F2).
-2.5 mA	"Private-Line" disable.
-5.5 mA	Mute receiver #2

The line output level and squelch adjustments for receiver #2 are also located on this module. For maintenance and testing, frequency #1 or frequency #2 can be manually selected by the switches on the front panel of the module.

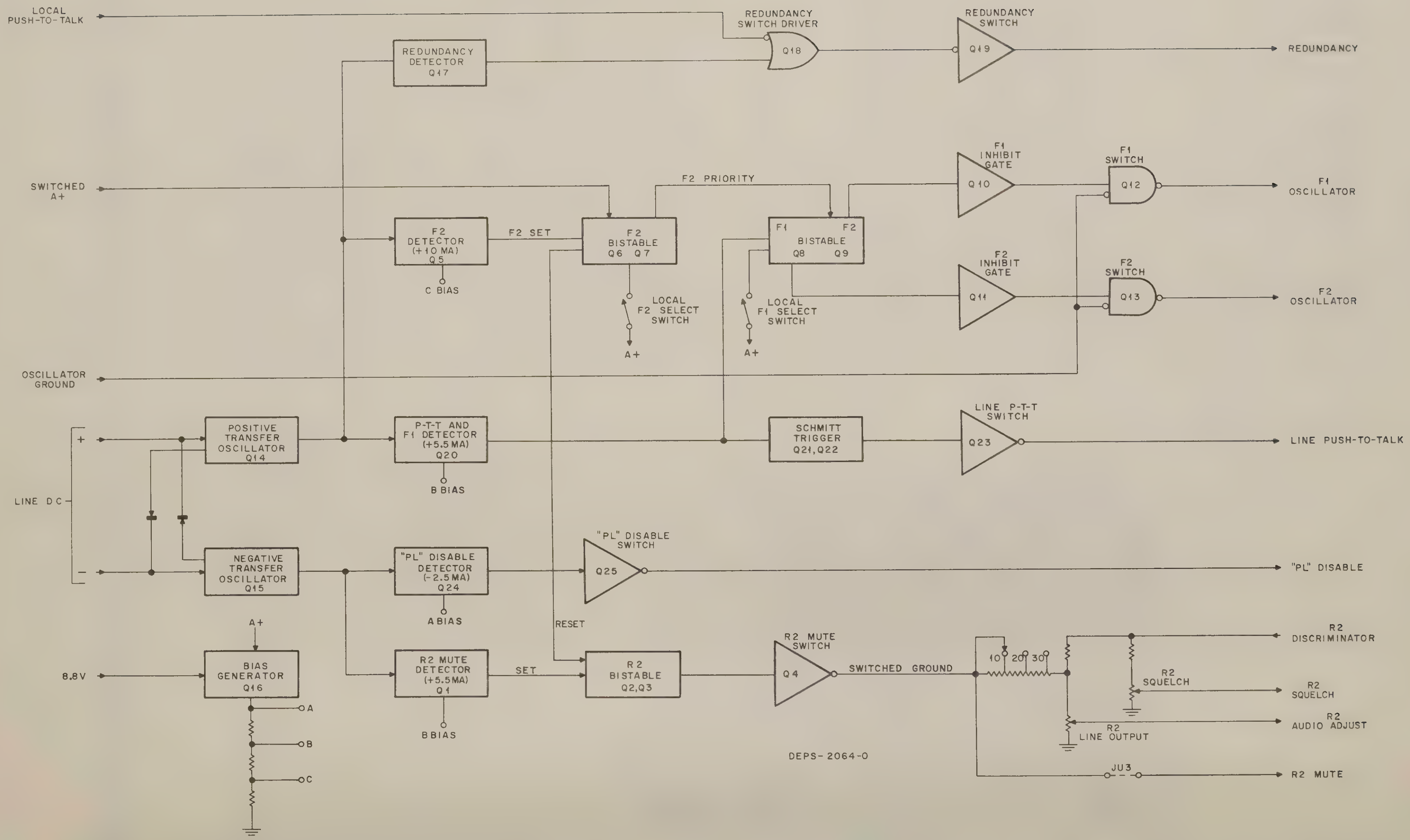
3. FUNCTIONAL OPERATION

a. General

The functions are performed by converting the positive or negative line currents to a 1 MHz oscillation whose amplitude is directly proportional to the magnitude of the applied dc current. The amplitude of the 1 MHz signal determines which functions are performed by overcoming fixed bias levels on the function detectors. The function detectors operate trigger or switching circuits which provide logic "high" or "low" outputs to other units of the station, which perform the desired function.

b. Transfer Oscillators

The positive and negative transfer oscillators are the terminations for the dc control currents from the control line. Each separate oscillator (positive or negative) is activated and powered by a like polarity line current; i.e., positive line current is routed by diodes to the positive transfer oscillator, and negative line currents are routed


LOCAL PUSH-TO-TALK
SWITCHED A+
OSCILLATOR GROUND
LINE DC
+
−
8.8V
REDUNDANCY DETECTOR Q47
REDUNDANCY SWITCH DRIVER
Q18
REDUNDANCY SWITCH
Q19
REDUNDANCY
F2 DETECTOR (+10 MA) Q5
C BIAS
F2 SET
F2 BISTABLE Q6 Q7
LOCAL F2 SELECT SWITCH
A+
F2 PRIORITY
F1 F2 BISTABLE Q8 Q9
LOCAL F1 SELECT SWITCH
F1 INHIBIT GATE
Q10
F2 INHIBIT GATE
Q11
F1 SWITCH
Q12
F2 SWITCH
Q13
F1 OSCILLATOR
F2 OSCILLATOR
POSITIVE TRANSFER OSCILLATOR Q14
NEGATIVE TRANSFER OSCILLATOR Q15
P-T-T AND F1 DETECTOR (+5.5 MA) Q20
B BIAS
SCHMITT TRIGGER Q21, Q22
LINE P-T-T SWITCH
Q23
LINE PUSH-TO-TALK
"PL" DISABLE DETECTOR (-2.5 MA) Q24
A BIAS
"PL" DISABLE SWITCH
Q25
"PL" DISABLE
RESET
BIAS GENERATOR Q16
A
B
C
R2 MUTE DETECTOR (+5.5 MA) Q1
SET
R2 BISTABLE Q2, Q3
R2 MUTE SWITCH
Q4
SWITCHED GROUND
10 20 30
R2 SQUELCH
R2 LINE OUTPUT
JU3
R2 DISCRIMINATOR
R2 SQUELCH
R2 AUDIO ADJUST
R2 MUTE
DEPS-2064-0

to the negative transfer oscillator. When line current is applied to either oscillator, it generates a signal at about 1 MHz with an amplitude proportional to the magnitude of the applied line current; that is, a higher line current will produce a higher-amplitude signal output.

c. Transmitter Keying F1

A positive line current of 5.5 mA or greater will key the transmitter. Both the redundancy circuit and the P-T-T (push-to-talk) circuit must be activated to provide this keying. As the name of the redundancy circuit implies, it somewhat duplicates the functions of the P-T-T circuit. Because both logic functions are required to key the transmitter, the redundancy circuit prevents transmitter keying as a result of failure in the P-T-T logic circuit.

With a 5.5 mA or greater dc line current applied to the positive transfer oscillator, the amplitude of its output exceeds the reverse bias on the P-T-T & F1 detector and turns on the stage. The dc bias is supplied by a constant current source regulator (bias generator). The P-T-T & F1 detector converts the 1 MHz oscillator signal into a dc voltage for use in the following logic circuitry. The Schmitt trigger transforms the dc input into a fast rise square wave output. When +5.5 mA or greater line current is present, the output of the Schmitt trigger is a logic "high". With no line current, its output is a logic "low" The Schmitt trigger output is inverted by the line P-T-T switch, providing a logic "low" when activated.

Any positive dc line current of 2.5 mA or greater produces sufficient 1 MHz output to activate redundancy detector Q17. The redundancy detector converts the 1 MHz input to a dc output "high" to activate the redundancy switch driver. This stage also acts as an OR gate, since it is activated by a "high" from the redundancy detector or a "low" from the local push-to-talk input (pin 6). The output "low" of the redundancy switch driver is inverted by redundancy switch Q19. This stage has a turn-off delay (capacitor C20 and resistor R58) to assure that redundancy is present at least as long as delayed push-to-talk.

The output of the P-T-T & F1 detector, or closure of the local F1 switch, resets the F1-F2 bistable. An output from the F1 section of the bistable activates the F2 inhibit switch. It, in turn, prevents the F2 switch from operating and removes ground from the F2 oscillator in the transmitter.

There is no output from the F2 section of the bistable at this time. Therefore, the F1 inhibit gate is off, which permits the F1 switch to activate. Ground is provided to the F1 oscillator.

d. Transmitter Keying F2

The transmitter is keyed on frequency #2 (F2) when positive 12.5 mA or greater line current is applied, or by local operation of the F2 switch and closure of the local push-to-talk switch.

At 12.5 mA line current, the P-T-T & F1 detector will remain activated, but the F2 detector will also be activated. It will provide a dc output to set the F2 bistable (operation of the local F2 switch will also perform this function). An output from the F2 bistable is applied to the F2 portion of the F1-F2 bistable. Although this stage already has an input to the F1 portion, the input to the F2 portion has priority. The output from the F1-F2 bistable at this time turns on the F1 inhibit gate and turns off the F2 inhibit gate. Ground is applied to the F2 oscillator and removed from the F1 oscillator.

At the end of the transmission, when the line current is decaying to zero, F1 is prevented from momentary operation by the slow release of the F2 bistable Q6-Q7, which does not revert to its initial state until the switched A+ fed in pin 13 is removed by its external controlling circuits.

e. "Private-Line" Disable

A dc line current of negative 2.5 mA or greater will disable the "Private-Line" tone-coded squelch circuit in the receiver (both receivers of two-receiver stations) and permit monitoring of all on-frequency signals. The output of the negative transfer oscillator with a -2.5 mA input is sufficient to activate the "PL" disable detector. Its dc output turns on the "PL" disable switch, which grounds the "PL" disable line output.

f. Receiver 2 Mute

In stations with two receivers, the second receiver can be muted or its audio attenuated by application of -5.5 mA or greater dc line current. The current will produce sufficient output from the negative transfer oscillator to overcome the bias on the R2 mute detector. The detector will provide a dc output to set the R2 bistable. It, in turn, will close the R2 mute switch and apply a switched ground output.

The switched ground output is used in one of four options depending upon jumper connections

made in the dc transfer module. If jumper JU3 is used, complete muting of the second receiver will occur. The jumper may be removed if attenuation, rather than complete muting, is desired. A resistance network which shunts the R2 LINE OUTPUT control is grounded by the R2 mute switch. With the resistance network grounded, the audio output signal amplitude is reduced. The amount of reduction is dependent upon the amount of resistance used. Jumpers JU1 and JU2 permit connections for 10 db, 20 db, or 30 db attenuation. The greatest attenuation is obtained by using the least resistance.

Once receiver 2 is muted, or attenuated, it can be reset by momentarily transmitting on frequency F2. Such action produces an output from the F2 bistable which resets the R2 bistable.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment on the station. To initially determine the location of the fault, operate the station by local means, and initiate the desired function. If the desired function is not performed, the station is at fault. If the desired function is performed, check dc line currents coming into the station. If line currents are normal, then the module may be at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 15	Ground
2, 11, 14, 16, 22	10K ohms to +12 volts dc.
3	Through 0-15 dc milliameter to +70-100 volts dc current source.
4	To minus of current source.
5	Cathode of 8.8 volt zener diode; (Motorola Part No. 48D82256C56) connect anode to ground.
7	10K ohms to ground.
12	To +12 volts dc; 56 ohms to pin 5.
13	spst switch to +12 volts dc.

c. Module Malfunction Location Techniques

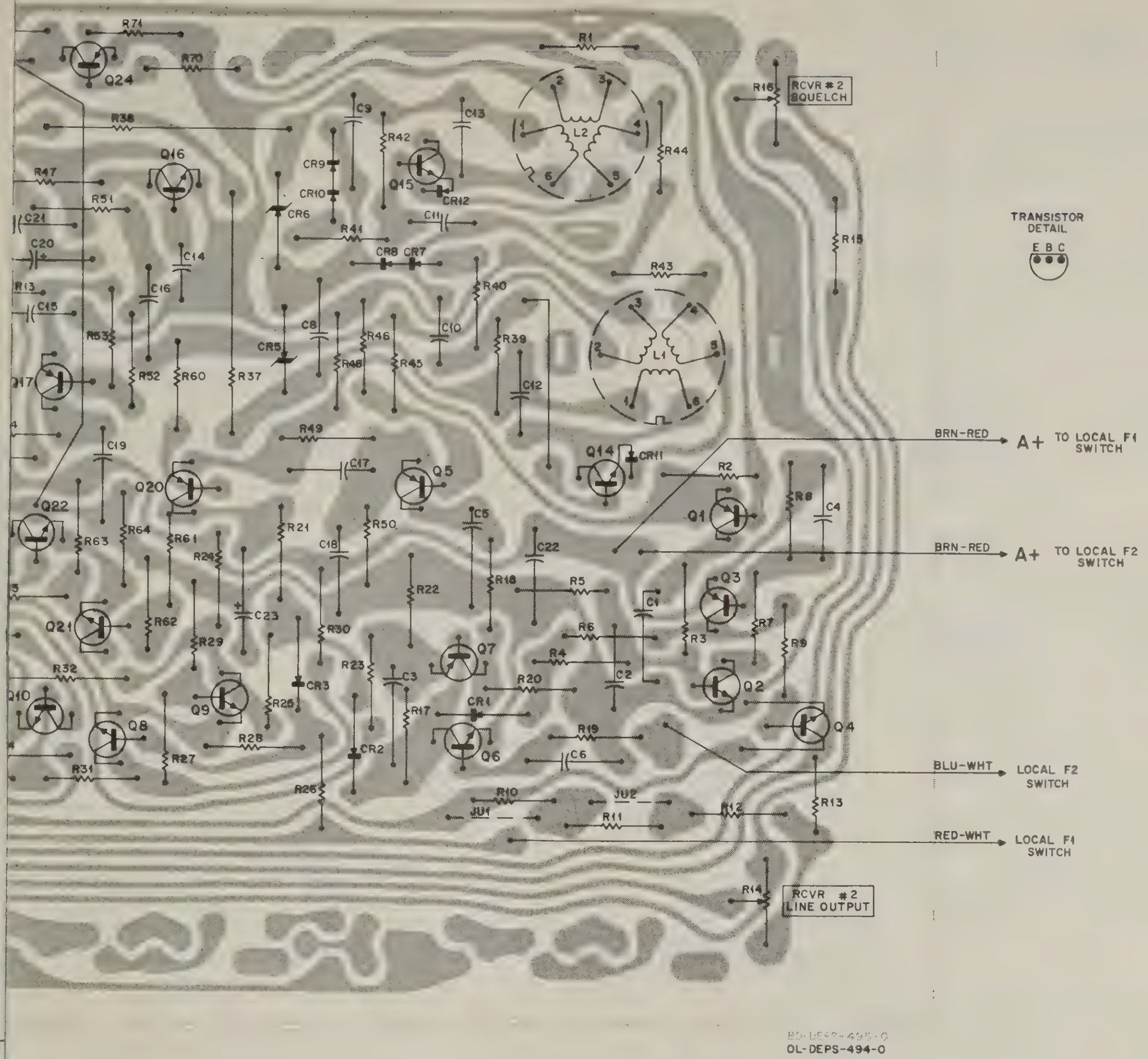
(1) Connect the module as indicated in the preceding table. Adjust the current source to produce +5.5 mA at pins 3 and 4. With a dc voltmeter, pin 7 should measure +12 volts; pin 11 should be at ground. Close the switch to apply +12 volts to pin 13. Pin 14 should go to ground. If these readings cannot be obtained, check the push-to-talk detector, Schmitt trigger, and line P-T-T switch stages Q20 through Q23, then the redundancy detector, redundancy switch driver, and redundancy switch stages Q17, Q18, and Q19. If pin 14 does not go to ground, check the F1-F2 bistable stage Q8-Q9, inhibit gate Q10, and the F1 switch Q12. Open the switch to remove +12 volts from pin 13.

(2) Apply +12.5 mA from the current source to pins 3 and 4. With a dc voltmeter, +12 volts should be measured at pin 7, and ground at pin 11. While maintaining the +12.5 mA, close the switch to apply +12 volts to pin 13. Pin 16 should go to ground. If the ground does not occur, check the F2 detector Q5, the F2 bistable Q6-Q7, the F1-F2 bistable Q8-Q9, the inhibit gate Q11, and the F2 switch Q13. Remove the +12.5 mA current and the +12 volts at pin 13; the readings at the pins should return to normal.

(3) Apply -2.5 mA to pins 3 and 4. Only pin 2 should go to ground. When the -2.5 mA is removed, pin 2 should return to +12 volts. If the function does not occur, check the "PL" disable detector Q24 and the "PL" disable switch Q25.

(4) Apply -5.5 mA from the current source to pins 3 and 4. Pin 2 should go to ground and the voltage at pin 22 should read approximately 2-3 volts. Remove the current source. The voltage at pin 2 should rise to +12 volts, and the voltage at pin 22 should remain at 2-3 volts. If the functions do not occur, check the R2 mute detector stage Q1 the R2 bistable Q2-Q3, and the R2 mute switch Q4.

(5) Repeat preceding step 2. Pin 22 should go to +12 volts.



SWITCHED LINE (+) 3

PTION	
OARD ANEL	2-FREQ. "PRIVATE-LINE"

ATION

SWITCHED LINE (−) 4

OP VOLTAGE IS
LE FOR APPRO-
WITH THE
TE FUNCTION,
IT CONDITION

FER OSCILLATOR ACTIVATED
POSITIVE
NEGATIVE

EPS-1738-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1176A DC Transfer Module
Schematic Diagram &
Circuit Board Detail
Motorola No. 63P81002E47-O
3/15/69-GM

made in the dc transfer module. If jumper JU3 is used, complete muting of the second receiver will occur. The jumper may be removed if attenuation, rather than complete muting, is desired. A resistance network which shunts the R2 LINE OUTPUT control is grounded by the R2 mute switch. With the resistance network grounded, the audio output signal amplitude is reduced. The amount of reduction is dependent upon the amount of resistance used. Jumpers JU1 and JU2 permit connections for 10 db, 20 db, or 30 db attenuation. The greatest attenuation is obtained by using the least resistance.

Once receiver 2 is muted, or attenuated, it can be reset by momentarily transmitting on frequency F2. Such action produces an output from the F2 bistable which resets the R2 bistable.

4. MAINTENANCE AND TROUBLESHOOTING

a. Techniques of Isolation

If a function cannot be performed from the remote control point, the malfunction may be isolated to either the remote equipment on the station. To initially determine the location of the fault, operate the station by local means, and initiate the desired function. If the desired function is not performed, the station is at fault. If the desired function is performed, check dc line currents coming into the station. If line currents are normal, then the module may be at fault.

b. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 15	Ground
2, 11, 14, 16, 22	10K ohms to +12 volts dc.
3	Through 0-15 dc milliameter to +70-100 volts dc current source.
4	To minus of current source.
5	Cathode of 8.8 volt zener diode; (Motorola Part No. 48D82256C56) connect anode to ground.
7	10K ohms to ground.
12	To +12 volts dc; 56 ohms to pin 5.
13	spst switch to +12 volts dc.

c. Module Malfunction Location Techniques

(1) Connect the module as indicated in the preceding table. Adjust the current source to produce +5.5 mA at pins 3 and 4. With a dc voltmeter, pin 7 should measure +12 volts; pin 11 should be at ground. Close the switch to apply +12 volts to pin 13. Pin 14 should go to ground. If these readings cannot be obtained, check the push-to-talk detector, Schmitt trigger, and line P-T-T switch stages Q20 through Q23, then the redundancy detector, redundancy switch driver, and redundancy switch stages Q17, Q18, and Q19. If pin 14 does not go to ground, check the F1-F2 bistable stage Q8-Q9, inhibit gate Q10, and the F1 switch Q12. Open the switch to remove +12 volts from pin 13.

(2) Apply +12.5 mA from the current source to pins 3 and 4. With a dc voltmeter, +12 volts should be measured at pin 7, and ground at pin 11. While maintaining the +12.5 mA, close the switch to apply +12 volts to pin 13. Pin 16 should go to ground. If the ground does not occur, check the F2 detector Q5, the F2 bistable Q6-Q7, the F1-F2 bistable Q8-Q9, the inhibit gate Q11, and the F2 switch Q13. Remove the +12.5 mA current and the +12 volts at pin 13; the readings at the pins should return to normal.

(3) Apply -2.5 mA to pins 3 and 4. Only pin 2 should go to ground. When the -2.5 mA is removed, pin 2 should return to +12 volts. If the function does not occur, check the "PL" disable detector Q24 and the "PL" disable switch Q25.

(4) Apply -5.5 mA from the current source to pins 3 and 4. Pin 2 should go to ground and the voltage at pin 22 should read approximately 2-3 volts. Remove the current source. The voltage at pin 2 should rise to +12 volts, and the voltage at pin 22 should remain at 2-3 volts. If the functions do not occur, check the R2 mute detector stage Q1 the R2 bistable Q2-Q3, and the R2 mute switch Q4.

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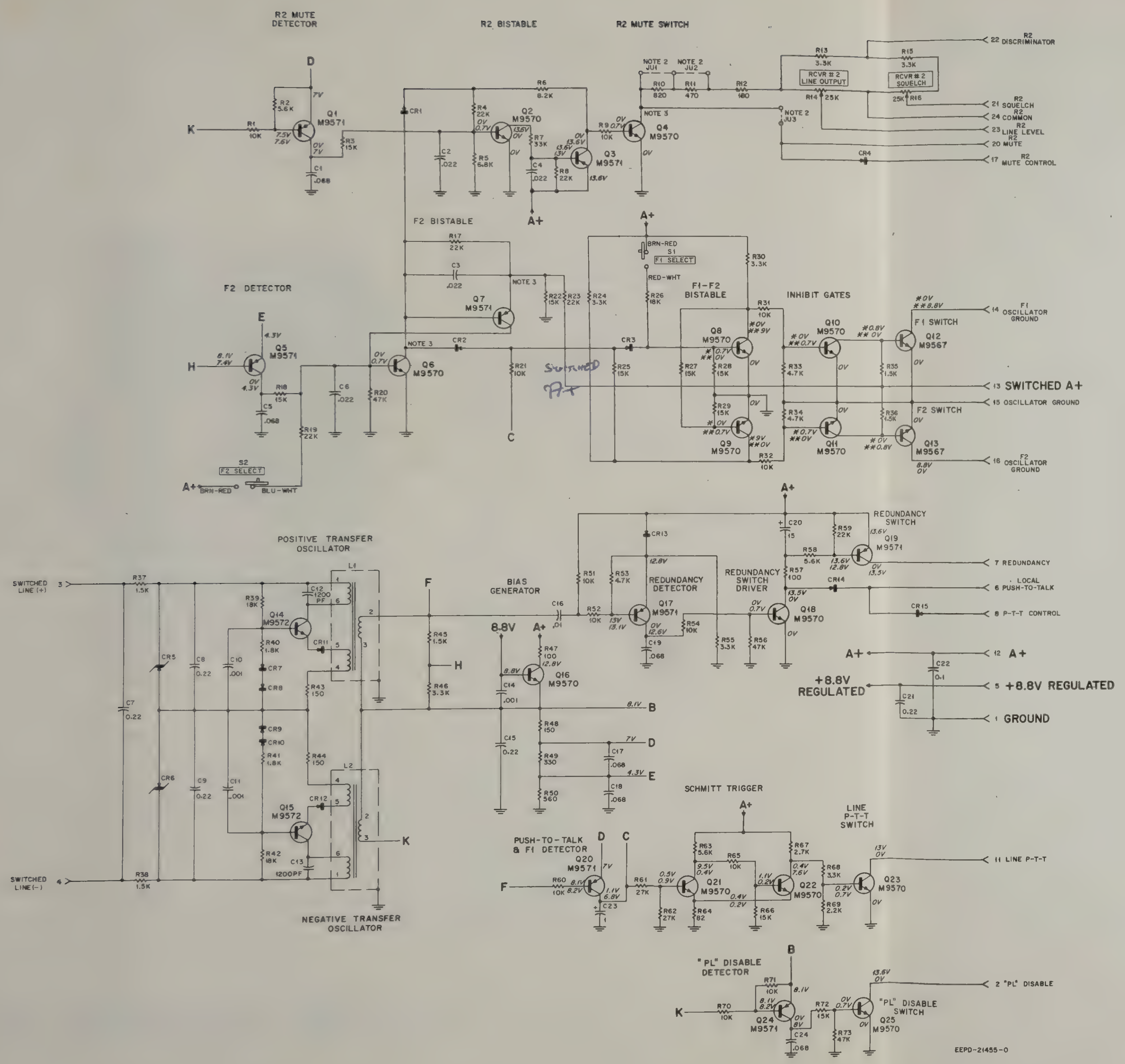
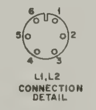
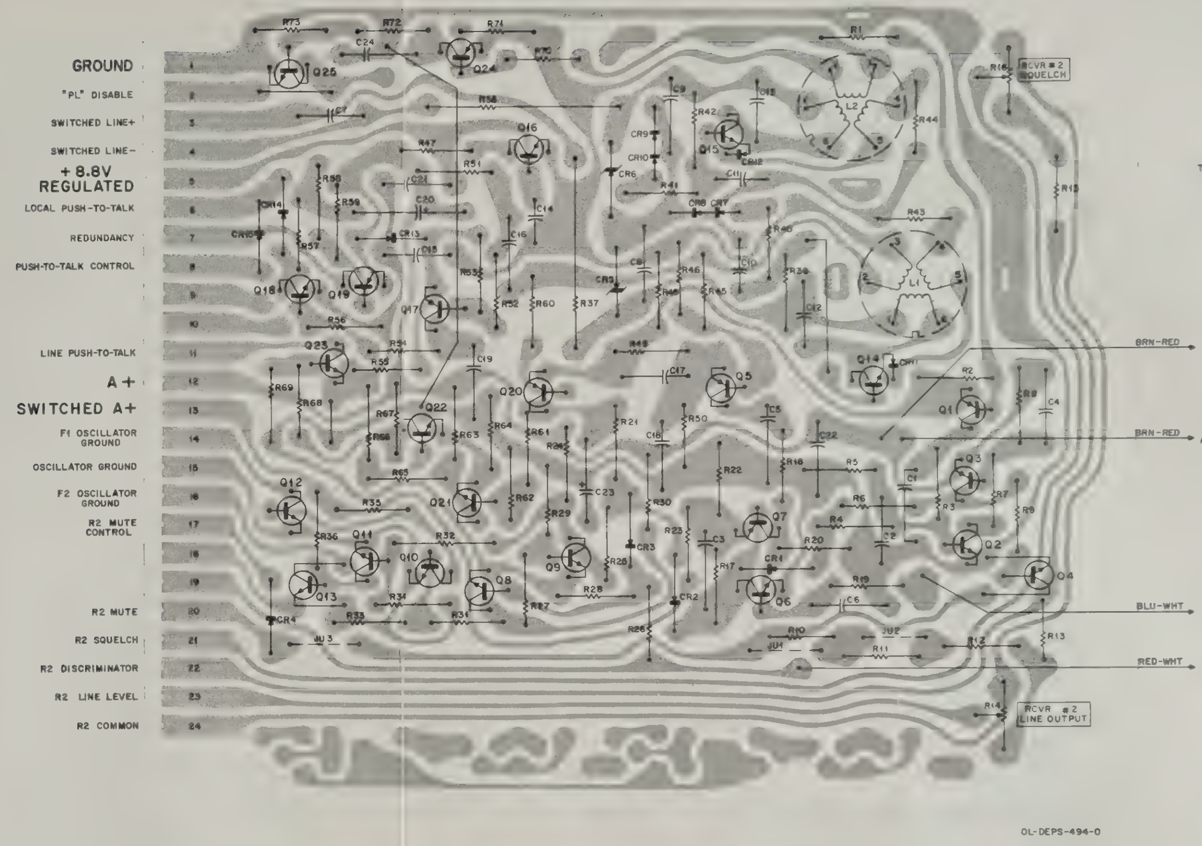






MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION	
TLN1176A		TLN8768A		DC TRANSFER BOARD	2-FREQ. "PRIVATE-LINE"
		TLN8801A		DC TRANSFER PANEL	

NOTES:

1. UNLESS OTHERWISE STATED:
   CAPACITOR VALUES ARE IN MICROFARADS.
   RESISTOR VALUES ARE IN OHMS (K = 1000).
2. IN 2-RECEIVER BASE STATIONS RECEIVER #2 ATTENUATION (R2 MUTE) IS ADJUSTABLE BY JUMPERS AS FOLLOWS:

ATTENUATION	JU1	JU2	JU3
10 db	OUT	OUT	OUT
20 db	IN	OUT	OUT
30 db	IN	IN	OUT
COMPLETE MUTING*	IN	IN	IN

*R12 MUST ALSO BE REMOVED.

3. WHERE TWO VOLTAGE READINGS ARE GIVEN: THE TOP VOLTAGE IS GIVEN WITH THE FUNCTION DEACTIVATED. SEE TABLE FOR APPROPRIATE FUNCTION. THE BOTTOM VOLTAGE IS GIVEN WITH THE FUNCTION ACTIVATED. SEE TABLE FOR APPROPRIATE FUNCTION. F1-F2 SELECT STAGE VOLTAGES SHOWN FOR TRANSMIT CONDITION AS FOLLOWS:

* = F1 SELECTED
** = F2 SELECTED

LINE CURRENT	FUNCTION ACTIVATED	TRANSFER OSCILLATOR ACTIVATED
+5.5 mA	P-T-T & F1 DETECTOR REDUNDANCY DETECTOR	POSITIVE
+12.5 mA	P-T-T & F1 DETECTOR F2 DETECTOR REDUNDANCY DETECTOR	POSITIVE
-2.5 mA	"PL" DISABLE DETECTOR	NEGATIVE
-5.5 mA	"PL" DISABLE DETECTOR R2 MUTE DETECTOR	NEGATIVE

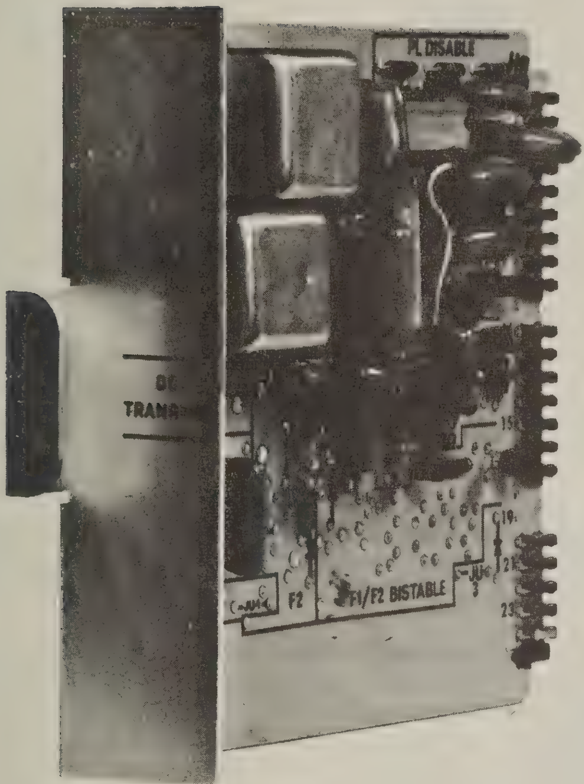
EPS-1738-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1176A DC Transfer Module
Schematic Diagram &
Circuit Board Detail
Motorola No. 63P81002E47-O
3/15/69-GM

DC TRANSFER MODULE

MODEL TLN1175A



1. DESCRIPTION

The TLN1175A DC Transfer Module is a fully transistorized, plug-in circuit module for the dc remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This dc transfer module converts the dc line currents from the remote control point to functions for operation of the base station.

DC CURRENT	OPERATION
zero	standby and receive operation
+5.5 mA	transmit
-2.5 mA	"Private-Line" disable

The line output level and squelch adjustments for receiver #2 are also located on this module. For maintenance and testing, frequency #1 or frequency #2 can be manually selected by the switches on the front panel of the module.

3. FUNCTIONAL OPERATION

a. General

The functions are performed by converting the positive or negative line currents to a 1 MHz oscillation whose amplitude is directly proportional to the magnitude of the applied dc current. The amplitude of the 1 MHz signal determines which functions are performed by overcoming fixed bias levels on the function detectors. The function detectors operate trigger or switching circuits which provide logic "high" or "low" outputs to other units of the station, which perform the desired function.

b. Transfer Oscillators

The positive and negative transfer oscillators are the terminations for the dc control currents from the control line. Each separate oscillator (positive or negative) is activated and powered by a like polarity line current; i.e., positive line current is routed by diodes to the positive transfer oscillator, and negative line currents are routed to the negative transfer oscillator. When line current is applied to either oscillator, it generates a signal at about 1 MHz with an amplitude proportional to the magnitude of the applied line

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REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8768A DC Transfer Board (2-Freq.) PL-255-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF; ±10%; 50 v: unl stated
C1, 5, 17, 18, 19, 24	8D82905G04	.068
C2, 3, 4, 6	8D82905G02	.022
C7, 8, 9, 15, 21	8D82905G11	0.22
C10, 11, 14	21D82187B20	.001; 100 v
C12, 13	21K874352	1200 pF; 300 v
C16	8D82905G01	.01
C20	23K865136	15; 25 v
C22	8D82905G07	0.1
C23	23D82783B08	1; 35 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR1, 2, 3, 4, 7, 8, 9, 10, 13, 14, 15	48C82392B03	silicon
CR5, 6	48D83461E12	silicon; Zener type; 27 v ±5%
CR11, 12	48C83654H01	silicon
		COIL, AF:
L1, 2	24C83008H01	oscillator
		TRANSISTOR: (NOTE)
Q1, 3, 5, 7, 17, 19, 20, 24	48R869571	P-N-P; type M9571
Q2, 4, 6, 8, 9, 10, 11, 16, 18, 21, 22, 23, 25	48R869570	N-P-N; type M9570
Q12, 13	48R869567	N-P-N; type M9567
Q14, 15	48R869572	N-P-N; type M9572
		RESISTOR, fixed: ±10%; 1/4 w: unl stated
R1, 52, 60, 70, 71	6S129668	10K ±5%
R2	6S129982	5.6K ±5%
R3, 18, 22, 25, 27, 28, 29, 66, 72	6S127805	15K
R4, 8, 17, 19, 23, 59	6S128685	22K
R5	6S128687	6.8K
R6	6S128686	8.2K
R7	6S127807	33K
R9, 21, 31, 32, 51, 54, 65	6S129225	10K
R10	6S129432	820
R11	6S127801	470
R12	6S129662	180
R13, 15, 24, 30, 55, 68	6S129231	3.3K
R14, 16	18C83083G03	variable: 25K ±30%
R20, 56, 73	6S128902	47K
R26, 39, 42	6S128904	18K
R33, 34	6S127804	4.7K
R35, 36	6S127803	1.5K
R37, 38	17D83027H03	1.5K; 5 w
R40, 41	6S129269	1.8K
R43, 44, 48	6S131276	150 ±5%
R45	6S129681	1.5K ±5%
R46	6S129981	3.3K ±5%
R47, 57	6S129753	100
R49	6S129806	330 ±5%
R50	6S129779	560 ±5%
R53	6S129669	4.7K ±5%
R58, 63	6S129433	5.6K
R61, 62	6S127806	27K
R64	6S129224	82
R67	6S129688	2.7K
R69	6S129804	2.2K
	NON-REFERENCED ITEM	
	26K858660	SHIELD, coil: for L1, L2

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

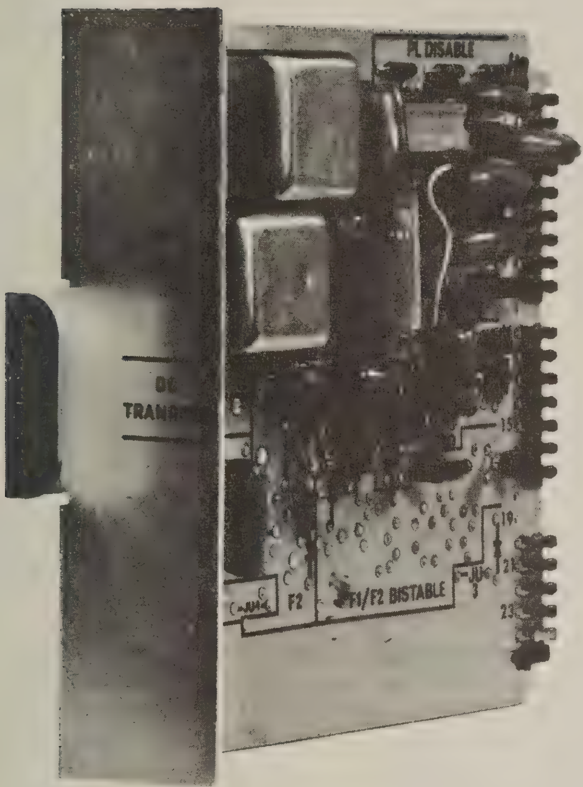
TLN8766A DC Transfer Panel (1-Freq.)
TLN8801A DC Transfer Panel (2-Freq.) PL-356-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
S1, 2	40B83468E01	SWITCH, slide: spst
	NON-REFERENCED ITEMS	
	64B83922G01	BRACKET, panel (TLN8766A)
	1V80781A28	PANEL BRACKET ASSY. (TLN8801A) includes ref. parts S1 and S2
	43B82721C01	INSULATOR, bushing (TLN8801A)
	45B83914G01	GUIDE, card: 2 req'd.
	40B83284H01	PLUG, keying

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

DC TRANSFER MODULE

MODEL TLN1175A



1. DESCRIPTION

The TLN1175A DC Transfer Module is a fully transistorized, plug-in circuit module for the dc remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed.

2. FUNCTIONS

This dc transfer module converts the dc line currents from the remote control point to functions for operation of the base station.

DC CURRENT	OPERATION
zero	standby and receive operation
+5.5 mA	transmit
-2.5 mA	"Private-Line" disable

The line output level and squelch adjustments for receiver #2 are also located on this module. For maintenance and testing, frequency #1 or frequency #2 can be manually selected by the switches on the front panel of the module.

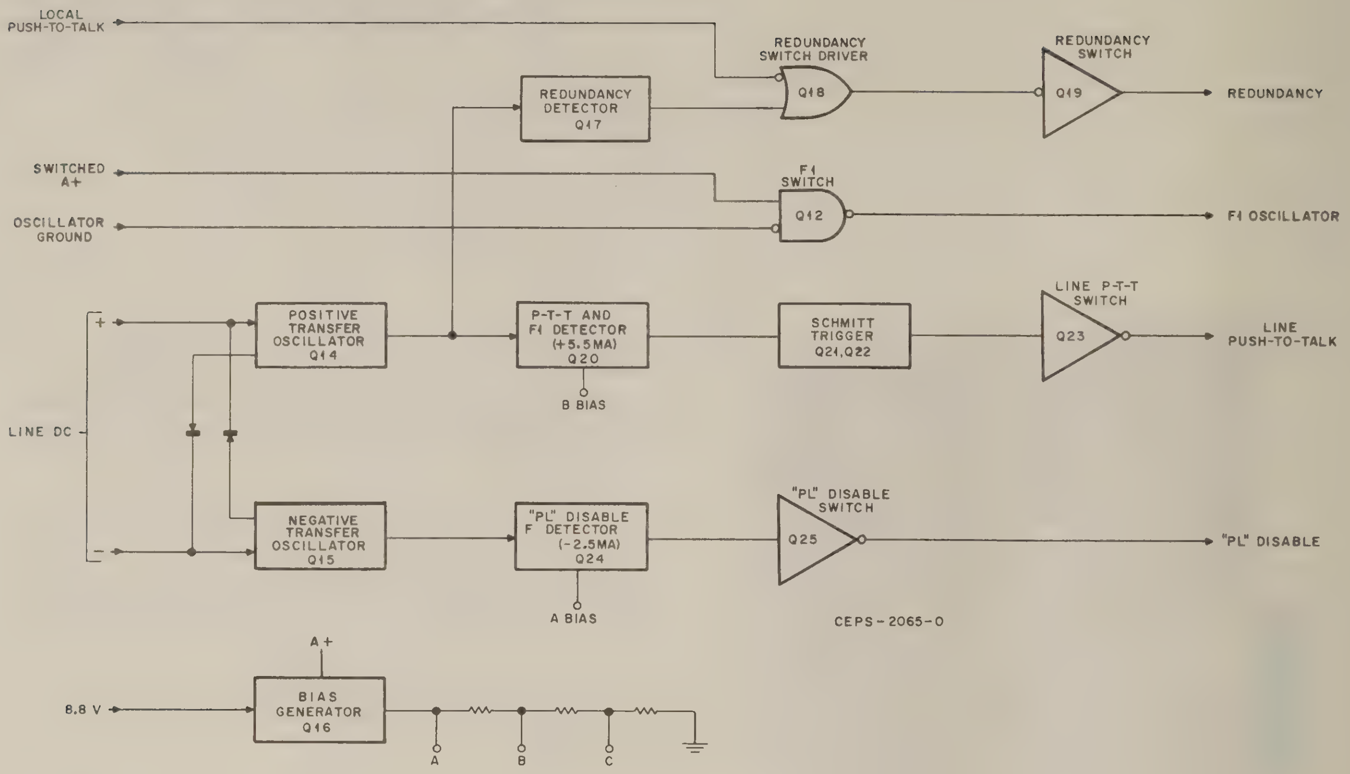
3. FUNCTIONAL OPERATION

a. General

The functions are performed by converting the positive or negative line currents to a 1 MHz oscillation whose amplitude is directly proportional to the magnitude of the applied dc current. The amplitude of the 1 MHz signal determines which functions are performed by overcoming fixed bias levels on the function detectors. The function detectors operate trigger or switching circuits which provide logic "high" or "low" outputs to other units of the station, which perform the desired function.

b. Transfer Oscillators

The positive and negative transfer oscillators are the terminations for the dc control currents from the control line. Each separate oscillator (positive or negative) is activated and powered by a like polarity line current; i.e., positive line current is routed by diodes to the positive transfer oscillator, and negative line currents are routed to the negative transfer oscillator. When line current is applied to either oscillator, it generates a signal at about 1 MHz with an amplitude proportional to the magnitude of the applied line



current; that is, a higher line current will produce a higher-amplitude signal output.

c. Transmitter Keying

A positive line current of 5.5 mA or greater will key the transmitter. Both the redundany circuit and the P-T-T (push-to-talk) circuit may be activated to provide this keying. As the name of the redundancy circuit implies, it somewhat duplicates the functions of the P-T-T circuit. Beacuse both logic functions are required to key the transmitter, the redundancy circuit prevents transmitter keying as a result of failure in the P-T-T logic circuit.

With a 5.5 mA or greater dc line current applied to the positive transfer oscillator, the amplitude of its output exceeds the reverse bias on P-T-T and F1 detector and turns on the stage. The dc bias is supplied by a constant current source regulator (bias generator). The P-T-T and F1 detector converts the 1 MHz osillator signal into a dc voltage for use in the following logic circuitry. The Schmitt trigger transforms the dc input into a fast rise square wave output. When +5.5 mA or greater line current is present, the output of the Schmitt trigger is a logic "high". With no line current, its output is a logic "low". The Schmitt trigger output is inverted by the line P-T-T switch, providing a logic "low" when activated.

Any positive dc line current of 2.5 mA or greater produces sufficient 1 MHz output to activate redundancy detector Q17. The redundancy detector converts the 1 MHz input to a dc output "high" to activate the redundancy switch driver. This stage also acts as an OR gate, since it is activated by a "high" from the redundancy detector or a "low" from the local push-to-talk input (pin 6). The output "low" of the redundancy switch driver is inverted by redundancy switch Q19. This stage has a turn-off delay (capacitor C20 and resistor R58) to assure that redundancy is present at least as long as delayed push-to-talk.

Switched A+ from the station logic module and exciter ground are both applied to the F1 switch to activate the stage and provide oscillator ground to the F1 oscillator in the transmitter.

d. "Private-Line" Disable

A dc line current of negative 2.5 mA or greater will disable the "Private-Line" tone-coded squelch circuit in the receiver (both receivers of two-receiver stations) and permit monitoring of

all on-frequency signals. The output of the negative transfer oscillator with a -2.5 mA input is sufficient to activate the "PL" disable detector. Its dc output turns on the "PL" disable switch, which grounds the "PL" disable line output.

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the module, remove the module, insert a Model TLN8799A PC Service Board, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis testing may be done if the proper power and terminations are connected to the module.

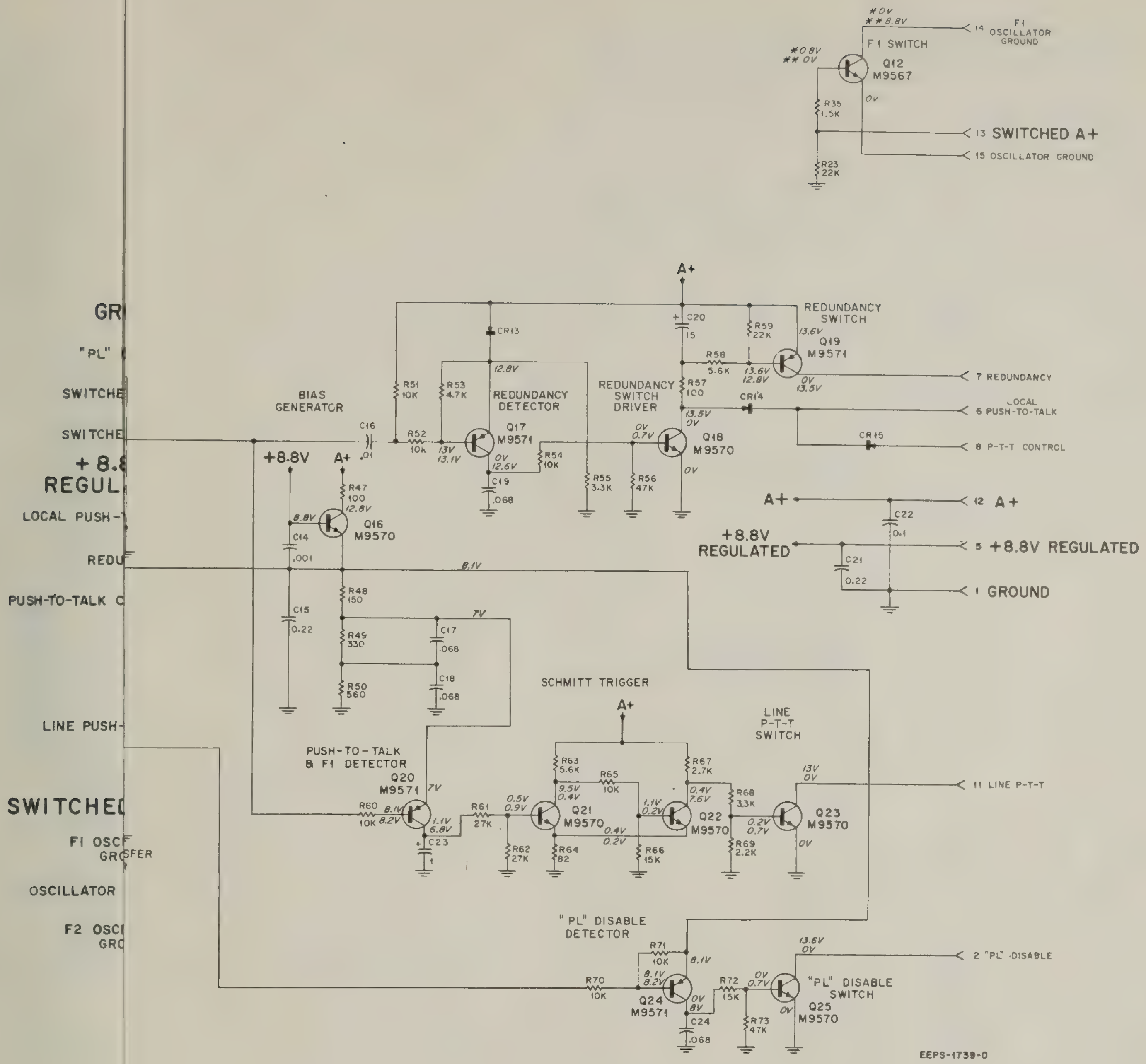
Make the following connections to the module:

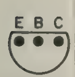
PIN NO.	CONNECT
1, 15	Ground
2, 11, 13, 14	10K ohms to +12 volts dc
3	Through 0-15 dc milliameter to +70-100 volts dc current source
4	to minus of current source
5	cathode of 8.8 volt zener diode (Motorola part no. 48D82256C56) connect anode to ground
7	10K ohms to ground
12	To +12 volts dc; 56 ohms to pin 5.

b. Module Malfunction Location Techniques

(1) Connect the module as indicated in the preceding table. Adjust the current source to produce +5.5 mA at pins 3 and 4. With a dc voltmeter, pin 7 should measure +12 volts; pin 11 and 14 should be at ground. If these readings cannot be obtained, check the Push-To-Talk Detector, Schmitt Trigger, and Line P-T-T Switch stages Q20 through Q23, then the Redundancy Detector, Redundancy Switch Driver, and Redundancy Switch stages Q17, Q18 and Q19. Check Q12.

(2) Apply -2.5 mA to pins 3 and 4. Only pin 2 should go to ground. When the -2.5 mA is removed, pin 2 should return to +12 volts. If the function does not occur, check the "PL" Disable Detector Q24 and the "PL" Disable Switch Q25.





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FREQ.
PRIVATE-LINE"

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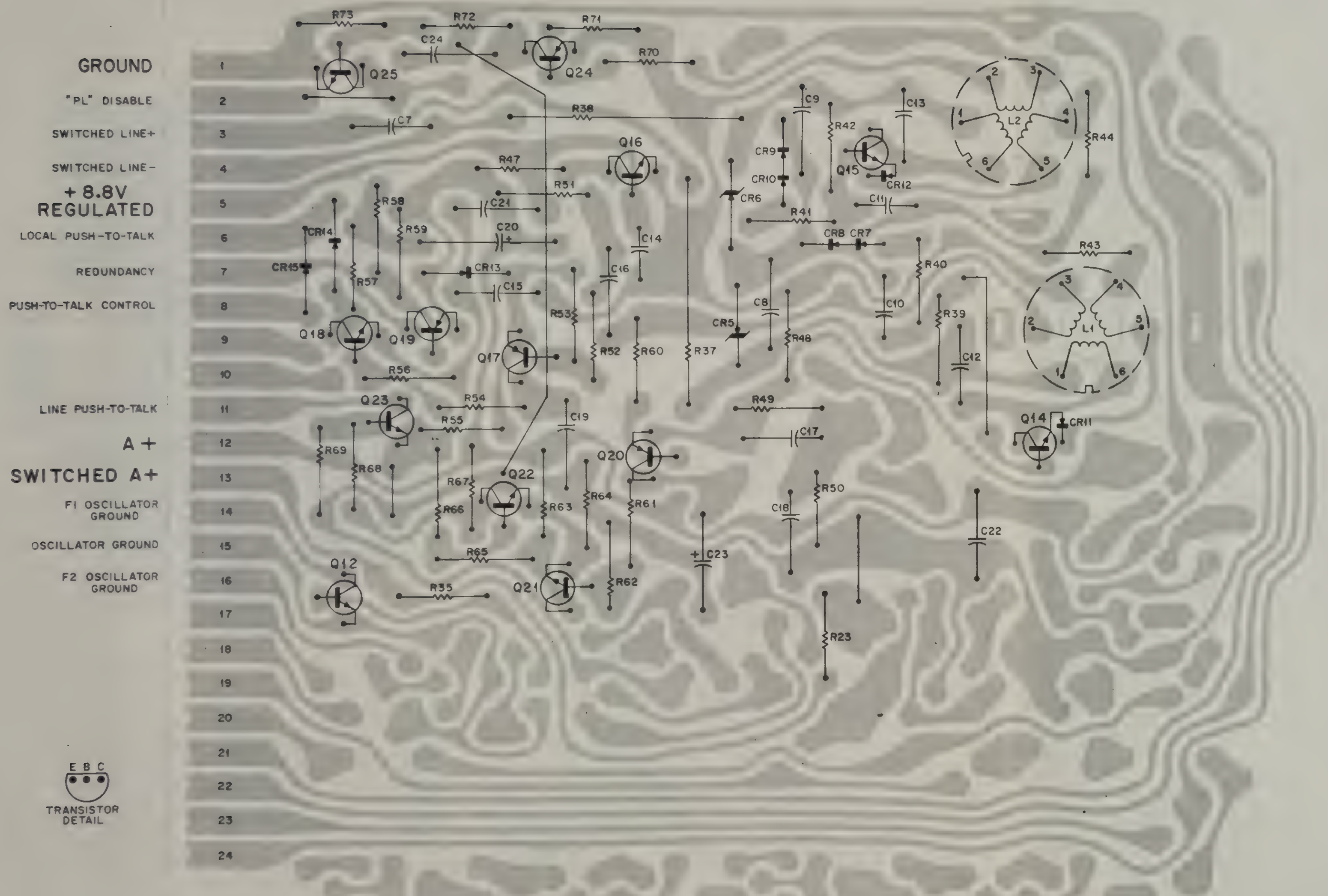
HE BOTTOM

EPS-1740-O

PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

TLN1175A DC Transfer Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E56-O1
3/15/69-GM



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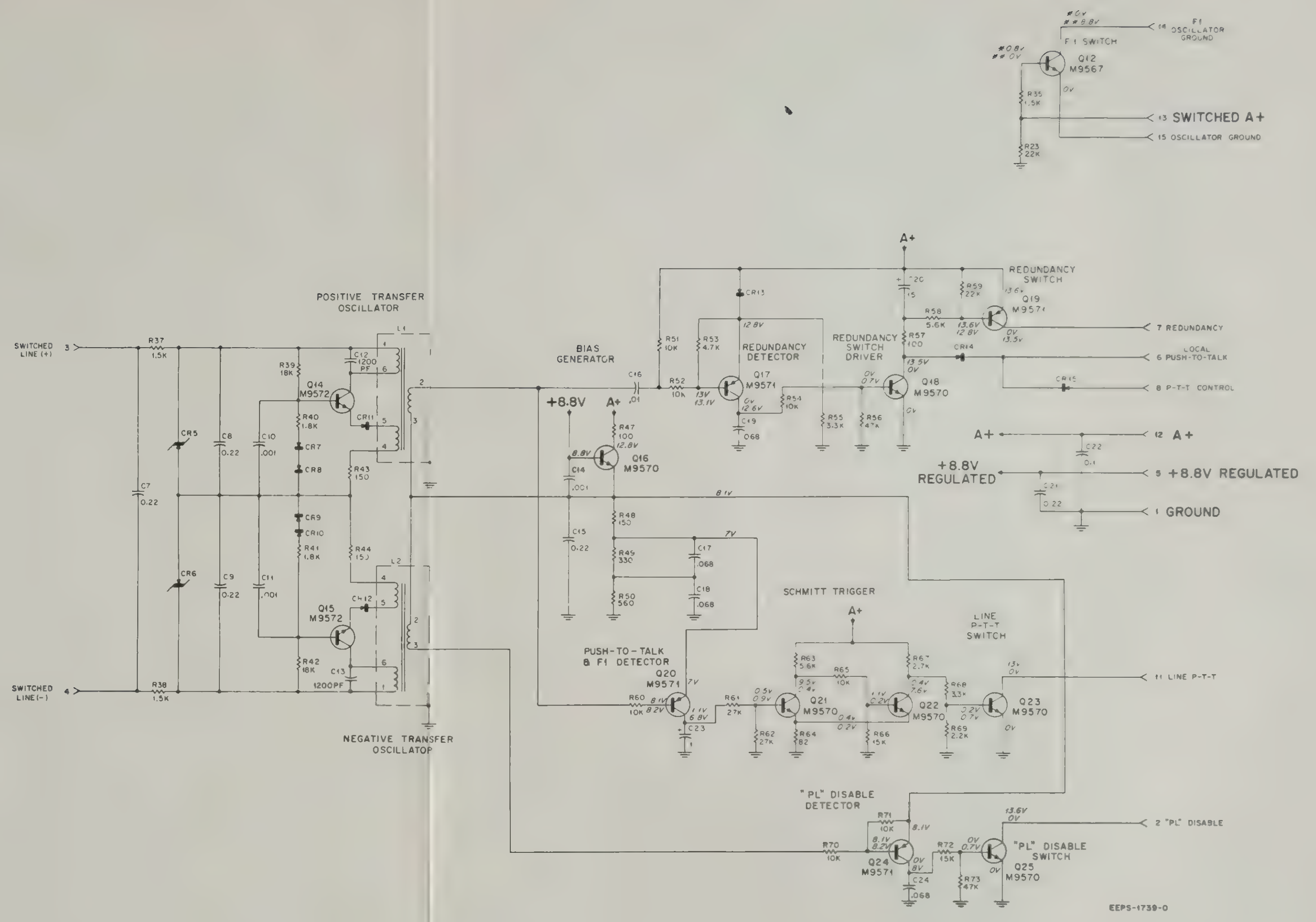


MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION	
TLN1175A				DC TRANSFER BOARD	1-FREQ.
				DC TRANSFER PANEL	"PRIVATE-LINE"

NOTES:

1. UNLESS OTHERWISE STATED:
   CAPACITOR VALUES ARE IN MICROFARADS
   RESISTOR VALUES ARE IN OHMS (K=1000)
2. EXCEPT FOR "PL" DISABLE STAGES WHERE TWO VOLTAGE READINGS ARE GIVEN: THE TOP VOLTAGE IS FOR THE RECEIVE CONDITION. THE BOTTOM VOLTAGE IS FOR THE TRANSMIT CONDITION.
3. WHERE TWO VOLTAGE READINGS ARE GIVEN FOR THE "PL" DISABLE STAGES: THE TOP VOLTAGE IS WITH THE FUNCTION DEACTIVATED. THE BOTTOM VOLTAGE IS WITH THE FUNCTION ACTIVATED.

EPS-1740-O

PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1175A DC Transfer Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E56-O1
3/15/69-GM

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8767A DC Transfer Board
(1-Freq., "Private-Line") PL-402-O

		CAPACITOR, fixed: uF; ±10%; 50 v: unl stated
C7, 8, 9, 15, 21	8D82905G11	0.22
C10, 11, 14	21D82187B20	.001; 100 v
C12, 13	21K874352	1200 pF; 300 v
C16	8D82905G01	.01
C17, 18, 19, 24	8D82905G04	.068
C20	23K865136	15; 25 v
C22	8D82905G07	0.1
C23	23D82783B08	1; 35 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR5, 6	48D83461E12	silicon; Zener type; 27 v ±5%
CR7, 8, 9, 10, 13, 14, 15	48C82392B03	silicon
CR11, 12	48C83654H01	silicon
		COIL, AF:
L1, 2	24C83008H01	oscillator
		TRANSISTOR: (NOTE)
Q12	48R869567	N-P-N; type M9567
Q14, 15	48R869572	N-P-N; type M9572
Q16, 18, 21, 22, 23, 25	48R869570	N-P-N; type M9570
Q17, 19, 20, 24	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R23, 59	6S128685	22K
R35	6S127803	1.5K
R37, 38	17D83027H03	1.5K; 5 w
R39, 42	6S128904	18K
R40, 41	6S129269	1.8K
R43, 44, 48	6S131276	150 ±5%
R47, 57	6S129753	100
R49	6S129806	330 ±5%
R50	6S129779	560 ±5%
R51, 54, 65	6S129225	10K
R52, 60, 70, 71	6S129668	10K ±5%
R53	6S129669	4.7K ±5%
R55, 68	6S129231	3.3K
R56, 73	6S128902	47K
R58, 63	6S129433	5.6K
R61, 62	6S127806	27K
R64	6S129224	82
R66, 72	6S127805	15K
R67	6S129688	2.7K
R69	6S129804	2.2K
	NON-REFERENCED ITEM	
	26K858660	SHIELD, coil: for L1, L2

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION

PARTS LIST

TLN8767A DC Transfer Board
(1-Freq., "Private-Line") PL-402-O

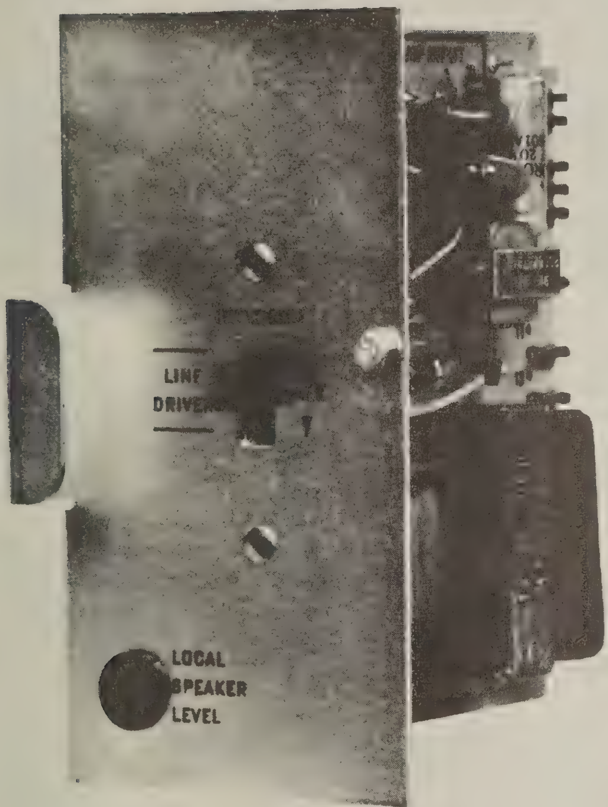
		CAPACITOR, fixed: uF; ±10%; 50 v: unl stated
C7, 8, 9, 15, 21	8D82905G11	0.22
C10, 11, 14	21D82187B20	.001; 100 v
C12, 13	21K874352	1200 pF; 300 v
C16	8D82905G01	.01
C17, 18, 19, 24	8D82905G04	.068
C20	23K865136	15; 25 v
C22	8D82905G07	0.1
C23	23D82783B08	1; 35 v
		SEMICONDUCTOR DEVICE, diode: (NOTE)
CR5, 6	48D83461E12	silicon; Zener type; 27 v ±5%
CR7, 8, 9, 10, 13, 14, 15	48C82392B03	silicon
CR11, 12	48C83654H01	silicon
		COIL, AF:
L1, 2	24C83008H01	oscillator
		TRANSISTOR: (NOTE)
Q12	48R869567	N-P-N; type M9567
Q14, 15	48R869572	N-P-N; type M9572
Q16, 18, 21, 22, 23, 25	48R869570	N-P-N; type M9570
Q17, 19, 20, 24	48R869571	P-N-P; type M9571
		RESISTOR, fixed: ±10%; 1/4 w; unl stated
R23, 59	6S128685	22K
R35	6S127803	1.5K
R37, 38	17D83027H03	1.5K; 5 w
R39, 42	6S128904	18K
R40, 41	6S129269	1.8K
R43, 44, 48	6S131276	150 ±5%
R47, 57	6S129753	100
R49	6S129806	330 ±5%
R50	6S129779	560 ±5%
R51, 54, 65	6S129225	10K
R52, 60, 70, 71	6S129668	10K ±5%
R53	6S129669	4.7K ±5%
R55, 68	6S129231	3.3K
R56, 73	6S128902	47K
R58, 63	6S129433	5.6K
R61, 62	6S127806	27K
R64	6S129224	82
R66, 72	6S127805	15K
R67	6S129688	2.7K
R69	6S129804	2.2K
NON-REFERENCED ITEM		
	26K858660	SHIELD, coil: for L1, L2

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

LINE DRIVER MODULE

MODEL TLN1172A



1. DESCRIPTION

The TLN1172A Line Driver Module is a fully transistorized, plug-in circuit module for the remote control chassis in Motorola base stations. All components and circuitry are mounted on a sturdy card with connecting terminals to mate with the interconnecting board of the chassis in which it is installed. This module is also used as the 4-Wire Audio Module in stations so equipped.

2. FUNCTIONS

The line driver module amplifies the output from the station receiver to a level suitable for application to the wire line between the station and the remote control point. It also contains the amplifier and switching facilities for intercommunication between a local speaker at the base station and the remote control console or desk set at the opposite end of the wire line.

Audio from the wire line is amplified before being applied to the transmitter exciter stages.

3. CIRCUIT DESCRIPTION

a. Receiver Audio To Line

When an audio output from the receiver enters the module on pin 4 or 5, it is amplified in preamplifier stage Q3. The signal then passes through phase inverter Q4. From the phase inverter, the signal goes to line driver Q6, and amplifier Q5 through blocking capacitor C10 and attenuating resistor R17, where it is 180 degrees out of phase with the signal at the base of Q6. The out-of-phase signals are fed to line driver transistors Q6 and Q7, which then apply the amplified audio signal to the line transformer and the line.

b. Line To Transmitter Exciter

The audio signal entering the transformer on the line windings is coupled out through the tertiary winding, terminals 7 and 9, into Exciter/Speaker Amplifier stage Q9. After amplification in this stage, which is operated as an

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emitter-follower, the signal is taken from the emitter and passed through jumper JU2 and pin 19 to the Station Logic Module and the transmitter exciter.

c. Intercommunication With The Remote Control Point

With the INTERCOM-TALK switch held in the TALK position, speaking into the local speaker on the base station routes the signal to intercom preamplifier stage Q2, intercom amplifier stage Q1, and through level adjustment network R1, R2, and R3. The output is adjustable by placement of a jumper for approximately +18 dbm, 0 dbm, or -8 dbm on the line. It is then applied to a phase inverter and amplifier pair which drive the line drivers. The line drivers are coupled to the line by transformer T1 and the voice message is sent over the wire line to the remote point.

The return signal on the wire line is coupled from the line side of transformer T1 through the tertiary winding to the Exciter/Speaker Amplifier and on to the SPEAKER LEVEL control. From the control, the signal passes through pin 23 to the receiver audio amplifier stages and back to the local speaker.

4. MAINTENANCE AND TROUBLESHOOTING

a. Servicing the Module

(1) Servicing the Module in the Remote Control Chassis

The module may be serviced while connected to the remote control chassis in the station. To gain access to the circuitry, remove the module, insert a Model TLN8799A Servicing Board Kit, and insert the module into this service extension. All points on the module are now accessible for voltage measurements, waveform observations, or other test functions.

(2) Servicing the Module Out of the Chassis

If the module is to be serviced without connection to its associated remote control chassis, testing may be done if the proper power and terminations are connected to the module.

Make the following connections to the module:

PIN NO.	CONNECT
1, 20	Ground
4	Audio oscillator through .1 uF
12	+12 volts dc
16	600 ohms to pin 17
17	AC voltmeter to pin 16
22	3.2 ohm speaker to ground

b. Module Malfunction Location Techniques

(1) Make the connections to the modules as indicated in the preceding table.

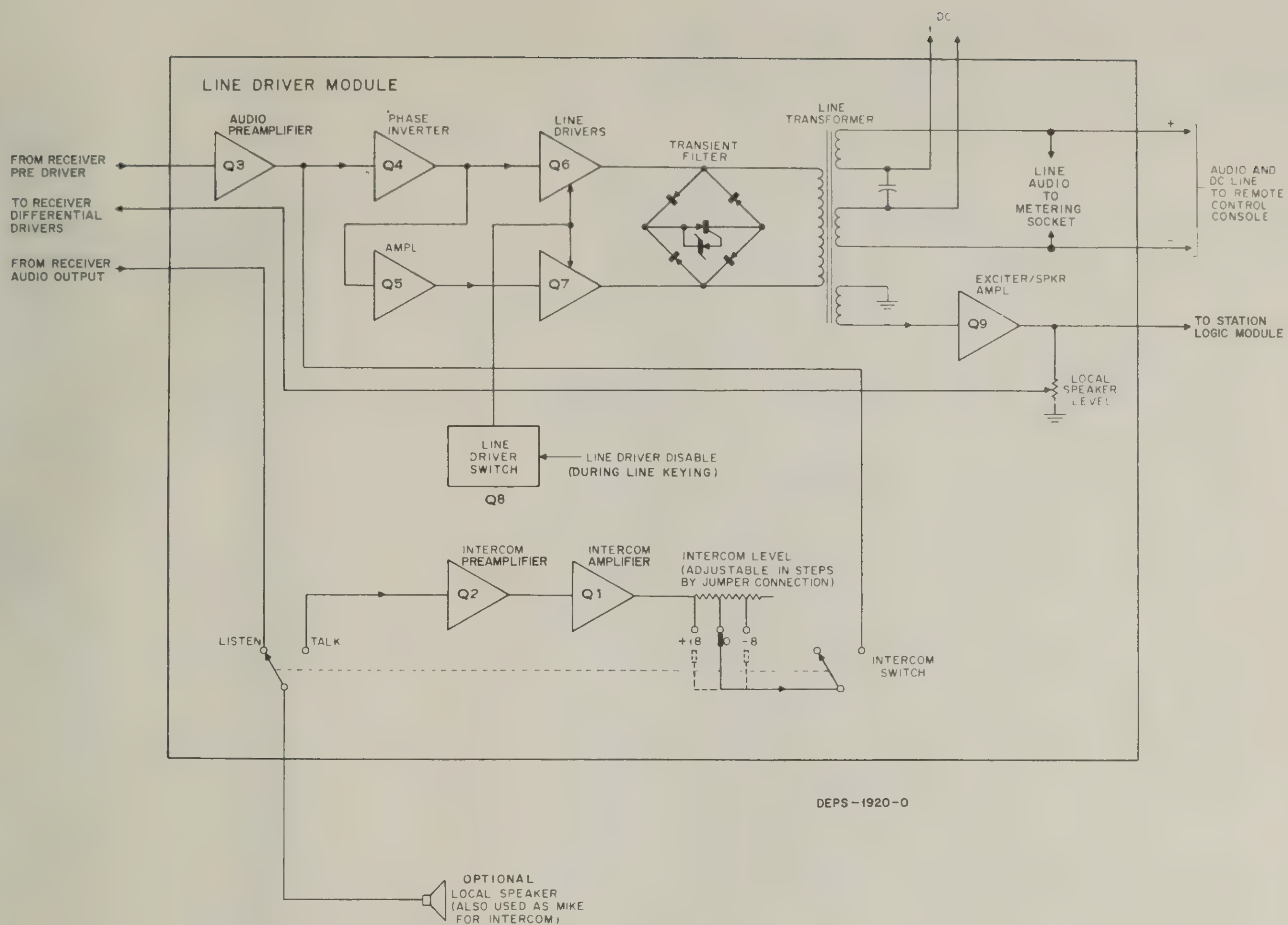
(2) Inject a 1000 Hz tone through the .1 uF capacitor into pin 4. With the tone level at -20 dbm, the voltage measured across the 600-ohm load (pins 16 and 17) should be approximately +14 dbm. If the level is much below this figure, check preamplifier stage Q3, then Phase Inverter Q4, Amplifier Q5, Line Drivers Q6 and Q7, and Line Driver Disable Switch Q8.

(3) Apply a ground to pin 2. The output measured at the 600-ohm load should drop to zero. If this does not occur, investigate diode CR7 and components of the Line Driver Disable Switch stage.

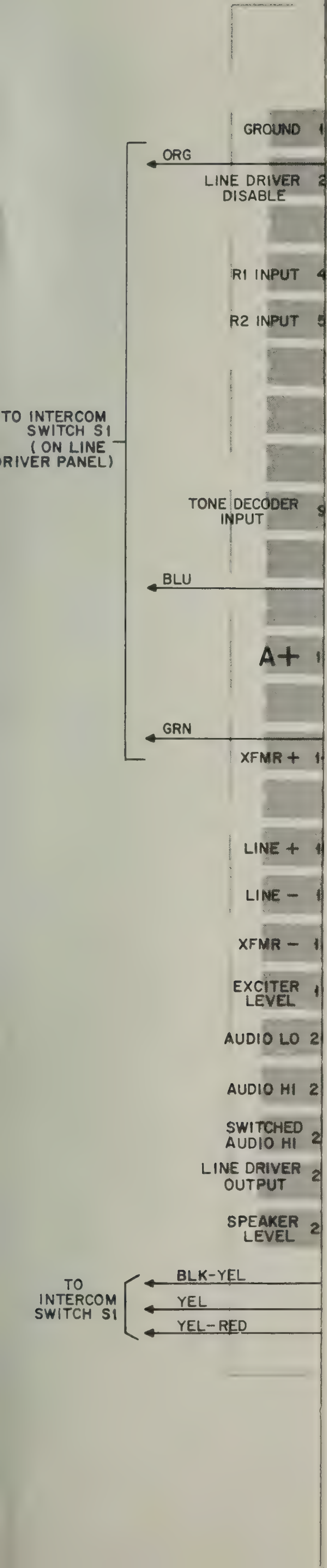
(4) With the same audio input as before, the output measured at pin 19 should be +8 dbm, or 6 db below the previously measured line output. If the appropriate level cannot be obtained, check Exciter/Speaker Amplifier stage Q9.

(5) Move the INTERCOM-TALK switch to the TALK position. Note the position of the AMP LEVEL jumper on the circuit board. Whistle loudly into the speaker connected to the module. The voltmeter connected to the load on pins 16 and 17 should peak at the level selected by the AMP LEVEL jumper (-8, 0, +18 dbm). If difficulty is experienced, check Intercom Amplifier stage Q1 or Intercom Preamplifier stage Q2.

(6) Remove the resistive load from pins 16 and 17. Check to see that continuity does not exist between these pins. If continuity is indicated check for a shorted capacitor (C16).



Functional Block Diagram



MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1172A		TLN8761A		LINE DRIVER BOARD
		TLN8762A		LINE DRIVER MODULE

NOTES:

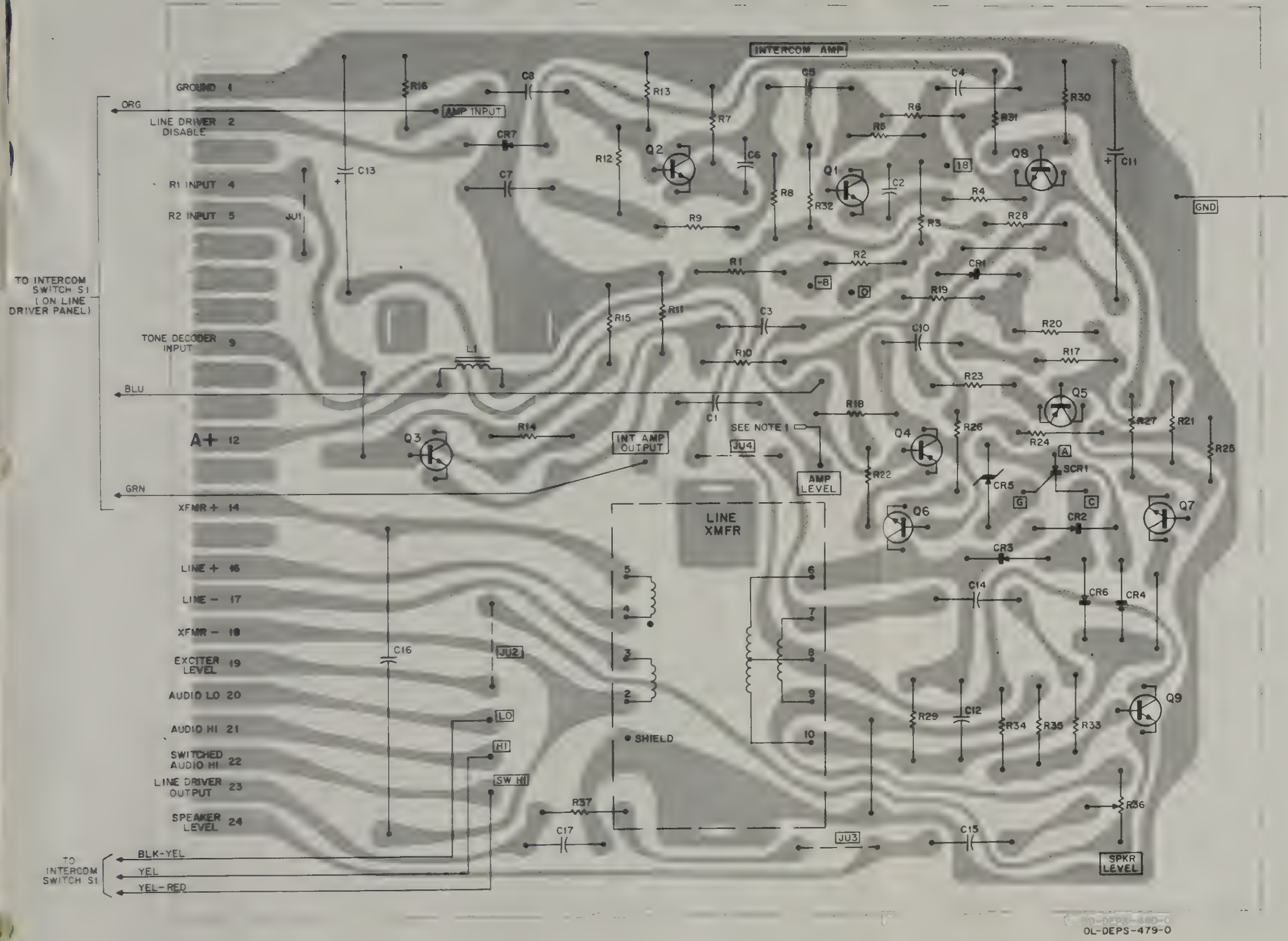
1. UNLESS OTHERWISE STATED:
   RESISTOR VALUES ARE IN OHMS (K=1000)
   CAPACITOR VALUES ARE IN MICROFARADS
2. AT POINTS SHOWING TWO VOLTAGE READINGS THE TOP VALUE (IN PARENTHESIS) IS FOR THE TRANSMIT CONDITION AND THE BOTTOM VALUE IS FOR THE RECEIVE OR STANDBY CONDITIONS.
3. THE "AMP LEVEL" JUMPER CONNECTS TO ONE OF THE THREE POINTS $\boxed{-8}$, $\boxed{0}$ OR $\boxed{+18}$ TO SELECT DESIRED INTERCOM TALK LEVEL.
4. JUMPER TABLE.

APPLICATION	JU1	JU2	JU3	JU4
BASE STATION WITH ONE RECEIVER: 2-WIRE AUDIO	OUT	IN	IN	IN
BASE STATION WITH TWO RECEIVERS: 2-WIRE AUDIO	IN	IN	IN	IN
BASE STATION WITH ONE RECEIVER: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE STATION WITH ONE RECEIVER: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE STATION WITH TWO RECEIVERS: 4-WIRE AUDIO, BOTH RECEIVERS ON SAME LINE (LINE DRIVER MODULE)	IN	OUT	IN	OUT
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; BOTH RECEIVERS ON SAME LINE (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; RECEIVERS ON SEPARATE LINES (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; RECEIVERS ON SEPARATE LINES (4-WIRE AUDIO MODULE)	IN	IN	OUT	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 2-WIRE AUDIO	OUT	IN	IN	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE (RA) STATION 2-WIRE AUDIO	OUT	IN	IN	IN
BASE (RA) STATION: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE (RA) STATION: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
REPEATER (RA) STATION: 2-WIRE AUDIO	OUT	IN	IN	IN
REPEATER (RA) STATION: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
REPEATER (RA) STATION: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN

EPS-1737-O

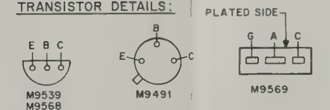
PARTS LIST SHOWN ON
BACK OF THIS DIAGRAM

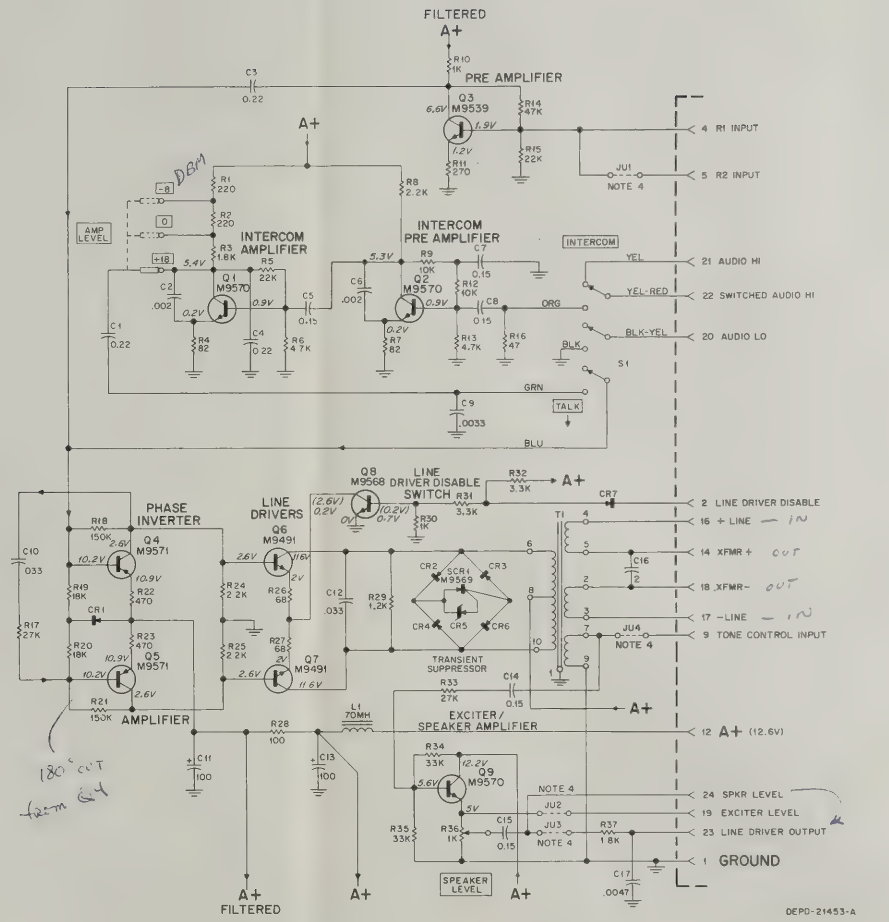
TLN1172A Line Driver Module
Or 4-Wire Audio Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E43-O
5/17/69-GM



NOTE:
1. AMP LEVEL JUMPER CONNECTS TO ONE OF THE THREE POINTS: +18, 0, OR -8.

TRANSISTOR DETAILS:





MODEL TABLE

MODEL	SUFFIX	KIT	SUFFIX	DESCRIPTION
TLN1172A		TLN8761A		LINE DRIVER BOARD
		TLN8762A		LINE DRIVER MODULE

NOTES

1. UNLESS OTHERWISE STATED
   RESISTOR VALUES ARE IN OHMS (K-1000)
   CAPACITOR VALUES ARE IN MICROFARADS
2. AT POINTS SHOWING TWO VOLTAGE READINGS THE TOP VALUE (IN PARENTHESIS) IS FOR THE TRANSMIT CONDITION AND THE BOTTOM VALUE IS FOR THE RECEIVE OR STANDBY CONDITIONS.
3. THE "AMP LEVEL" JUMPER CONNECTS TO ONE OF THE THREE POINTS -8, 0 OR +18 TO SELECT DESIRED INTERCOM TALK LEVEL.
4. JUMPER TABLE.

APPLICATION	JU1	JU2	JU3	JU4
BASE STATION WITH ONE RECEIVER: 2-WIRE AUDIO	OUT	IN	IN	IN
BASE STATION WITH TWO RECEIVERS: 2-WIRE AUDIO	IN	IN	IN	IN
BASE STATION WITH ONE RECEIVER: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE STATION WITH ONE RECEIVER. 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE STATION WITH TWO RECEIVERS. 4-WIRE AUDIO, BOTH RECEIVERS ON SAME LINE (LINE DRIVER MODULE)	IN	OUT	IN	OUT
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; BOTH RECEIVERS ON SAME LINE (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE STATIONS WITH TWO RECEIVER 4-WIRE AUDIO; RECEIVERS ON SEPARATE LINES (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE STATIONS WITH TWO RECEIVERS: 4-WIRE AUDIO; RECEIVERS ON SEPARATE LINES (4-WIRE AUDIO MODULE)	IN	IN	OUT	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 2-WIRE AUDIO	OUT	IN	IN	IN
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
REPEATER (RT) STATION WITH WIRE LINE CONTROL: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
BASE (RA) STATION 2-WIRE AUDIO	OUT	IN	IN	IN
BASE (RA) STATION: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
BASE (RA) STATION: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN
REPEATER (RA) STATION 2-WIRE AUDIO	OUT	IN	IN	IN
REPEATER (RA) STATION: 4-WIRE AUDIO (LINE DRIVER MODULE)	OUT	OUT	IN	OUT
REPEATER (RA) STATION: 4-WIRE AUDIO (4-WIRE AUDIO MODULE)	OUT	IN	OUT	IN

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PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

TLN1172A Line Driver Module
Or 4-Wire Audio Module
Schematic Diagram & Circuit Board Detail
Motorola No. 63P81002E43-O
5/17/69-GM

PARTS LIST

TLN8761A Line Driver Board — PL-253-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; unl stated
C1, 3, 4	8D82905G11	.22; 50 v
C2, 6	21D82428B25	.002 ±20%; 500 v
C5, 7, 8, 14, 15	8D82905G05	0.15; 50 v
C10, 12	8D82905G08	.033; 50 v
C11, 13	23D82601A25	100 +150-10%; 20 v
C16	8D82045F05	2; 350 v
C17, 33	8D82905G26	.0047; 100 v
		SEMICONDUCTOR DEVICE, diode: (SEE NOTE)
CR1, 7	48C82392B03	silicon; RD1343
CR2, 3, 4, 6	48C82466H01	silicon
CR5	48D82256C20	zener type; 27 v
		COIL, choke:
L1	25B82878A03	70 mH
		TRANSISTOR: (SEE NOTE)
Q1, 2, 9	48R869570	N-P-N; M9570
Q3	48R869539	N-P-N; M9539
Q4, 5	48R869471	P-N-P; M9471
Q6, 7	48R869491	N-P-N; M9491
Q8	48R869568	N-P-N; M9568
		RESISTOR, fixed: ±10%; 1/4 w;
R1, 2	6S127800	220
R3, 37	6S129269	1.8K
R4, 7	6S129224	82
R5, 15	6S128685	22K
R6, 13	6S127804	4.7K
R8,	6S128689	2.2K
R9, 12	6S129225	10K
R10, 30	6S127802	1K
R11	6S129752	270
R14	6S128902	47K
R16	6S129233	47
R17, 33	6S127806	27K
R18, 21	6S128683	150K ±5%
R19, 20	6S131526	18K ±5%
R22, 23	6S127801	470
R24, 25	6S129804	2.2K ±5%
R26, 27	6S129861	68
R28	6S129753	100
R29	6S129235	1.2K
R31, 32	6S129231	3.3K
R34, 35	6S127807	33K
R36	18C83083G04	variable: 1K ±30%
		RECTIFIER:
SCR1	48R869569	silicon controlled; M9569
		TRANSFORMER, line-driver:
T1	25C83000H01	pri: No. 1; term. 2 & 3; 150 ohms; No. 2; term. 4 & 5; 150 ohms; sec; No. 1; term. 6 & 10 w/8 tap; total res. 1.2K ohms; No. 2; term. 7 & 9; 600 ohms
		NON-REFERENCED ITEMS
	9B83011H01	RECEPTACLE, board mtg: 17 req'd.
	9A83445D01	PIN, terminal: 3 req'd.

TLN8762A Line Driver Panel — PL-354-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed:
C9	21D82428B10	.0033 uF ±10%; 100 v
		SWITCH, slide:
S1	40B83881C01	3 pdt
		NON-REFERENCED ITEMS
	1V80781A47	PANEL ASSY. (riveted) incl. ref. part S1
	43B82721C01	BUSHING, insulator
	45B83914G01	GUIDE, printed circuit board
	46B83284H01	PLUG, keying